

1972

Aristotle's Relation to Democritus Reconsidered and Vindicated as Against the Criticism of Harold Cherniss

Richard W. Baldes
Loyola University Chicago

Recommended Citation

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ARISTOTLE'S RELATION TO DEMOCRITUS RECONSIDERED
AND VINDICATED AS AGAINST THE CRITICISM OF
HAROLD CHERNISS

BY
RICHARD W. BALDES

DISSERTATION
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY IN THE DEPARTMENT OF
CLASSICAL STUDIES OF LOYOLA UNIVERSITY

CHICAGO

1972

VITA

Richard W. Baldes was born on September 12, 1930, in Chicago, Illinois, where he attended elementary schools and the first two years of high school. He graduated from high school in 1948 in Milwaukee, Wisconsin, where he attended Concordia College for two years.

Thereupon, in 1950, he entered Concordia Seminary, St. Louis, where he received a Bachelor of Arts degree in 1952. From 1952 to 1953 he attended Washington University in St. Louis; and in 1953 he resumed his studies at Concordia Seminary and graduated from there in 1956, at which time he also received a Bachelor of Divinity degree from that institution.

He served as a Lutheran minister in parishes at Lily, Wisconsin, and at Plainfield, Illinois from 1956 to 1961.

In 1958 he entered Loyola University of Chicago as a part-time graduate student in the Department of Classical Studies and was awarded a Master of Arts degree on February 7, 1962.

In 1961 he was awarded a National Defense Education Act scholarship and worked in the Origins of Western Civilization program at Loyola University of Chicago until 1963. During this time he also taught on a part-time basis for the History Department.

In 1963 he accepted the position of Instructor in the Department of Classical Languages at the University of Alabama at Tuscaloosa, Alabama. He has been teaching there since then on a full-time basis.

He passed the eight examinations qualifying him as a doctoral candidate at Loyola University of Chicago between November of 1968 and November of 1969. He successfully defended his dissertation on December 20, 1971, and now plans to be awarded the degree of Doctor of Philosophy in the Department of Classical Studies on February 12, 1972.

ARISTOTLE'S RELATIONS TO DEMOCRITUS RECONSIDERED AND
VINDICATED AS AGAINST THE CRITICISM OF HAROLD CHERNISS

Richard W. Baldes, Ph. D.

Loyola University of Chicago, 1972

Director: Lothar Nurnberger, S. J.

Harold Cherniss has charged that Aristotle is guilty of unfairness in both his reports and criticisms of Presocratic philosophers. These charges--with reference to Democritus at least--are without any real foundation. It can reasonably--in the light of other ancient information which we have about Democritus--be held that Aristotle's reports of his teachings were accurate and that his criticisms were justified.

Aristotle's reports and criticisms of Democritus are taken up in terms of four major issues which divide these two men: the existence of permanent atomic units, the existence of a void, a knowledge of reality by correspondence, and his treatment of the four 'causes'.

Taking these points up in order, we observe that Aristotle rightly points out that on none of these four issues was Democritus' teaching warrented by the empirical facts. As to the existence of atoms, Aristotle points out that there is no reason why division must stop at a given degree of smallness, that atomic doctrine is an unwarranted denial of the empirical evidence which we have for continuity, and that atomism is founded on a mistaken notion of the meaning of 'what is'.

Secondly, although void was posited to account for motion, it fails to do so. The existence of void as that which is absolutely intangible cannot in principle be supported by any real evidence. Void--like the atoms--was proposed because of a mistaken notion of what 'what is' and 'what is not' means.

Furthermore, if our knowledge of the real world of atomically structured physical objects is by a correspondence which is both vague and inconsistent, we are after all reduced to relying on the very phenomena which the atomic theory had rejected.

Finally, Democritus' atomism, since it recognizes only an infinite series of absolutely determined forced motions, makes of all the universe an utterly mechanical device with absolutely no distinction between mechanical and natural events, between animate and inanimate objects--a distinction which seems obvious.

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INTRODUCTION

The Problem

In 1935 Harold Cherniss published his well-known book, Aristotle's Criticism of Presocratic Philosophy.¹ Its general tendency is to show that Aristotle's reports of the teachings of the Presocratic philosophers are not to be implicitly and naively trusted, because Aristotle is guilty of verbal misrepresentations of texts which we possess, guilty, in fact, of conflicting passages on the same point, of "wilful misrepresentation" (page 352), of trying to twist and distort Presocratic theories in order to set them into bold relief and thus more firmly establish his own theory.

But this is no new discovery on Cherniss' part; the problem had been recognized for at least some thirty years at the time of the publication of his book.² Cherniss' work is in that respect merely the systematic culmination of those earlier efforts. But the mere fact that Cherniss has had predecessors in his serious doubts about Aristotle's reliability in regard

¹Harold Cherniss, Aristotle's Criticism of Presocratic Philosophy (reprint, New York: Octagon Press, 1964).

²The reviewer of Cherniss' book in Revue de Metaphysique et de Morale, XLIV (1937), supplement to the April issue, pp. 11-12, points out that Rivaud was the first to recognize the problem. Others who questioned Aristotle's reliability in this respect likely go back even further in time, but that is not important.

to the Presocratics has not yet and is not likely to lessen the impact of this work in the area of Presocratic scholarship. Much is to be said for its insights, for its exhaustive scholarship, and for its relentless adherence to its central thesis. It is not likely soon to have a rival of the same scope.

Indeed, Cherniss' efforts to cast into bold relief the tendentiousness of ancient literary reports of the Presocratics has already long since found imitation and continuance in the work of J. B. McDiarmid.³ The latter contends in substance that Theophrastus is not to be trusted either as an independent source of information on the Presocratics, but that he rather uncritically repeated what Aristotle had said and has at times conflated two distinct reports by Aristotle. Thus, instead of helping us better to understand Presocratic teachings and theories, Theophrastus only confuses the issue and is "even less trustworthy than Aristotle" (page 133) himself.

But this approach has implications not only for the reports of Aristotle and Theophrastus themselves, but also for the bulk of the doxographic tradition, which in one way or another seems to be basically dependent on Aristotle and Theophrastus. Thus, to cast doubts on the reports of Aristotle and Theophrastus is to cast that same sort of--and perhaps even more serious--doubt on the doxographic tradition as a whole, in which, if conjecture on that score is correct, there are

³John B. McDiarmid, "Theophrastus on the Presocratic Causes," Harvard Studies in Classical Philology, LXI (1953), 85-156.

further corruptions due to the influence of Stoic and Epicurean teachings. In the face of such doubt and distrust we could do little in most cases but despair over the prospects of any insight at all into Presocratic philosophy;⁴ we would in many cases be relegated to guessing about fragments snatched out of context.

But, to return to Aristotle himself, these are indeed serious charges to lay at the door of a philosopher of the caliber of Aristotle, especially since he himself is so acutely aware of consistency and of the varying meanings of words. It is true that in many cases the terminology of the report does not belong to the predecessor in question but to Aristotle himself, and that to one who is not aware of this practice of Aristotle such usage of Aristotelian terminology may indeed be misleading. But this is not the major charge which is made against Aristotle; he is charged rather with presenting a wrong teaching, with deliberate alteration of the theories of the Presocratics, with setting up 'straw men' to knock down, with giving conflicting reports about the same theory. Such charges even under ordinary circumstances are only to be made for grave reasons, and not on the weak and conjectural evidence presented by Cherniss; but in Aristotle's case one ought reasonably be doubly hesitant to make such charges.

⁴This is substantiated by many and was pointed out in particular by A. E. Taylor in his review of Cherniss' book in Mind, XLVI (1937), 247-250; if one discredits Aristotle and considers the Theophrastan doxographical tradition as infected, there is too little to go on.

Furthermore, Jaeger, in his review of Cherniss' book,⁵ points out that Cherniss is making the same sort of error that he accuses Aristotle of making: he measures Aristotle by a standard alien to him; Cherniss' attitude itself becomes unhistorical; and the only difference is that Aristotle does it not unconsciously in behalf of a philosophical world view, while Cherniss does it consciously and in behalf of a historical truth.⁶ Thus, paradoxically, Cherniss fails to consider adequately Aristotle's own view-point, fails basically to consider the question of whether or not Aristotle's remarks were justified apart from the question of whether by our modern philosophic and scientific standards Aristotle was right or wrong.

There is, on the other hand, a growing tendency to revive some trust in Aristotle's accounts of Presocratic philosophers while taking into consideration the criticisms which Cherniss has offered. One general attempt in this direction is that of W. K. C. Guthrie, both in his general account, "Aristotle as Historian,"⁷ and in his particular accounts of the Presocratics in his A History of Greek Philosophy.⁸ He does point out that

⁵Werner Jaeger, in his review in American Journal of Philology, LVIII (1937), 350-356.

⁶Roughly this same criticism is taken up by W. K. C. Guthrie, "Aristotle as Historian," Journal of Hellenic Studies, LXXVII (1957), 35-41.

⁷Ibid.

⁸W. K. C. Guthrie, A History of Greek Philosophy (Cambridge: Cambridge University Press, 1962--); the first three three volumes deal with the Presocratics.

Aristotle is usually quite careful to indicate where his report ends and his criticism begins, to distinguish his reports from the logical conclusions he draws from the teachings of the Presocratics, to distinguish secondary information from what he has learned about the teachings more directly. Thus Aristotle is represented as being a better source of information than Cherniss had given him credit for; and Aristotle is indeed to be trusted, if only we take the trouble to read him carefully.

This is substantially the point at which the problem of the reliability of Aristotle as a witness to the teachings of the Presocratics stands. No one thus far has attempted to do Cherniss' work again and subject all of his remarks about Aristotle's reliability to closer scrutiny; that would indeed be an awesome task!

Nestle has suggested that there are two feasible ways to approach this problem: one is to concentrate on individual thinkers, and the other is to concentrate on the main problems which Aristotle raises.⁹ It would seem to be equally reasonable--if not more reasonable--to combine both methods, to examine Aristotle's criticisms of an individual author in terms of the philosophical issues that Aristotle sees as being at stake. This approach would have the advantages to be gained by both methods; it would allow a somewhat closer scrutiny of the reports and criticisms of Aristotle; it would concentrate on

⁹Wilhelm Nestle's review of Cherniss' book in Philologische Wochenschrift, LVI (1936), cols. 1329-32. Nestle says that Cherniss was right in choosing the second alternative.

fundamental and specific issues between Aristotle and the philosopher involved, and thus not suffer from having to jump back and forth from one philosophical school to another, as Cherniss is forced to do; it would avoid the mistake of 'lumping philosophical schools together' without a precise indication of the respect in which their teachings are different. Indeed, there is a prospect of a clearer and fairer account of Aristotle's reports and criticisms of the Presocratic philosophers to be gained by using this approach.

In more recent years the atomic theories of modern physicists have centered an increasing amount of interest on the relative contributions of two imposing figures of ancient Greece--Democritus and Aristotle--to this modern system. So, perhaps because of Democritus' advocacy of atomism in the ancient world, there seems to be a natural tendency to sympathize with his position and perhaps also a latent inclination to read into its ancient form some of the modern aspects of atomism and to assume in the light of modern science that in some instances Aristotle's criticism of it was wrong or misguided. Because of this a closer examination of the issues which Aristotle sees as dividing his position from that of Democritus and his reasons for rejecting the latter's atomism would seem to be particularly interesting and profitable.

But there are also further reasons for choosing to re-examine Aristotle's reports and criticisms of Democritus in particular. Aristotle on several occasions makes a point of

praising Democritus not only for the broad scope of his theory¹⁰ but also for his consistency in including all things into a single, unified, rational system, and beginning with nature just as it is.¹¹ This certainly implies that Aristotle was well acquainted with Democritus' theory and considered it as a unified whole, and that particularly in Democritus' case Aristotle was not likely guilty of picking at individual doctrines without at least a fundamental glance at the place of such doctrines in the context of the whole system. It indicates in Aristotle a high degree of respect for the teachings of his rival, teachings which we thus have every reason to expect that Aristotle will treat fairly.

Thus Aristotle's criticism of Democritus might be in a sense considered critical. For, if on closer examination we do indeed find Aristotle's reports and criticisms reasonably fair and justified, it becomes more likely that this will also be the case with other Presocratics; if, on the other hand, we tend to find Cherniss' charges of unfairness substantiated, his case for similar treatment of the other Presocratics will receive even more support.

It seems therefore both feasible and reasonable to examine more critically the reliability of Aristotle over against

¹⁰Gen. et Corr. 1.1, 315a35: περὶ πάντων φροντίσαι. 1.8, 324b35-325a1: περὶ πάντων.

¹¹Gen. et Corr. 1.8, 325a1-2: ἐνὶ λόγῳ . . . ἀρχὴν ποιησάμενοι κατὰ φύσιν ἥπερ ἐστίν.

the teachings of Democritus: the issues between them are rather clearly drawn; and we have on Aristotle's part an implicit claim for the honorable treatment of his rival. There is every reason to expect that charges like those of Cherniss can thus be profitably investigated.

Furthermore, what is undertaken in this paper is only a beginning, for it would seem both reasonable and profitable to continue this sort of an investigation in two further directions. First of all, in regard to the teachings of Democritus himself, it seems equally important to examine the reports and criticisms of his teachings in other ancient philosophical authors who contribute substantially to the information which we have about Democritus--primarily, Theophrastus, Cicero, Plutarch, Sextus Empiricus, and Simplicius. Their own treatment of Democritus and his teachings is likely to reflect a changing concern with the various philosophical issues that were current during the lives of these ancient authors. What can be learned from such a chronological investigation may well run parallel to and illuminate the development of the doxographical tradition. At any rate it will put us in a better position to understand and appreciate the information that they do give us about Democritus.

Secondly, it seems equally appropriate and necessary to examine Aristotle's reports and criticisms of other major Presocratic authors, for, though it is not likely, Democritus may be a special case, and what is found to hold true in regard to

Aristotle's use of Democritus' teachings may not hold true with regard to other Presocratics. There is also too much danger in gathering philosophers into schools, for a specific criticism may apply in different respects to different individuals of the same school. These men need to be treated as distinct individuals as much as possible in order to be properly understood. This is not to deny any similarity of doctrine between individuals--such similarities will be inevitable when a number of men approach a problem in the same way--but only to insure that we understand precisely in what respects they are similar and in what respects they are different. Only so can Aristotle's accounts be more fairly judged.

The Method

More specifically, the format to be followed here will be to examine Aristotle's treatment of Democritus in terms of the major philosophical issues which divide them; and Aristotle himself can best tell us what these issues are. There are, as seems evident from reading Aristotle, three such fundamental issues: the meaning of 'what is' and of 'what is not', the problem of sense-perception and knowledge, and the question of the adequacy of Democritus' explanation of physical objects and events. The first of these is readily broken down into two sub-problems: the existence of permanent atomic units and the existence of a void. The second issue will be seen to involve as well the problem of the soul, of the reality of 'secondary qualities', and of the mutual generation

of the elements. The third is more readily recognizable as the question of the 'four causes'.

Within each of these major issues it seems reasonable to review and check the teachings of Democritus as they apply to that particular issue. Wherever possible and appropriate this will be done with reference to Democritus' own terminology, being careful to distinguish it and the teaching it involves from any limited and technical meaning which is peculiar to Aristotle. It should thus be possible to avoid the trap of letting Aristotle's arguments carry without any real justification for them.

In connection with this examination of original terminology there is to be a more detailed examination of Aristotle's report of the teachings involved in each issue. This is to include as well some acknowledgement of the background and basis of the particular doctrine, the philosophical issue to which Democritus was speaking, and then a reasonable account of the doctrine along with any obvious implications.

Then, on the basis of the above, there is to follow in each instance an examination of the criticisms which Aristotle directs against the teaching involved in the issue at hand. This examination will be primarily concerned with the question of whether or not Aristotle's criticisms are justified, whether or not they are warranted by the teaching he is opposing and by his basis for judgment. As interesting as the question may be, there will be no primary concern with the matter of

whether either Aristotle or Democritus is right or wrong in terms of advanced modern science or in terms of the unique philosophical issues of modern philosophy--indeed, there may be no definitive answers to those sorts of questions at all.

Nor, for that reason, will this paper be primarily concerned with what Democritus might have said in reply to these criticisms unless there is some substantial evidence to support such a reply. To proceed otherwise would be to read into the teaching of Democritus something which is not in fact there; it would lead us into pure speculation and conjecture, and that is of no real help.

Finally, this paper is written under several assumptions and specifications which will become more apparent as one reads on. But it may not be out of place here to forewarn the reader. First of all, there will be no attempt made here to distinguish in fact the teachings of Leucippus from those of Democritus. Though there has been some debate on the question, one may on the whole safely take their teachings together.¹² The few instances in which Leucippus alone is cited in Aristotle can be shown from parallel citations to involve teachings which apply to Democritus as well. Nothing can really be gained for our purposes by entering into the problem of separating and distinguishing these two men.

Secondly and obviously, there will be no treatment of a

¹²Following Guthrie, A History of Greek Philosophy, op. cit., vol. 2, p. 382, note 2.

teaching or criticism by 'schools' without a clear specification of the respect in which Democritus is to be classed or criticized in that way. In this connection the term 'atomist' is intended to refer specifically to Leucippus and Democritus, and thus for all practical purposes to Democritus himself, unless a broader use of the term is specifically indicated.

Finally, the problem will be approached without assuming with Cherniss that Aristotle is unfair. This is to be a cautious attempt to read what Aristotle has to say about Democritus carefully and without prejudice, hesitating without grave reason to find Aristotle guilty of gross misrepresentation. Aristotle likely had access to the works of Democritus, could read him in context, and knew what he was talking about much more so than we do who have no such complete or coherent primary source available. This seems to be the only way of dealing effectively with the problem without getting involved in the circularity of checking Aristotle by a doxographic tradition which is in turn dependent on Aristotle's own accounts.

Thus, what is proposed here is a re-evaluation of Aristotle's criticisms of Democritus, one written to show that this position of trusting Aristotle is not only just as tenable as that of Cherniss, but even more reasonable; it is written to demonstrate in fact that Aristotle is after all basically reliable, if only we take the trouble to read and understand him and to assess precisely what it is that he is saying in regard to Democritus.

CHAPTER I

WHAT CONSTITUTES A REAL UNIT?

The Problem

As was specified in the Introduction, it will be the approach of this paper to examine Aristotle's accounts of Democritus in terms of the basic issues which divide the teachings of the one from those of the other. Now one of the most obvious and fundamental issues which separate them revolves around the question of what constitutes a real unit. In general, it is quite obvious that it was Democritus' position that the only real unit was a permanent, impassible, and minute body of matter which he called an 'atom'; whether considered alone or as a part of a physical object this atom retained in eternal actuality its character as the only real unit. Aristotle contends, on the other hand, that there is not sufficient justification for positing such an indivisible atom as a true and permanent unit, that such a theory runs counter to both logic and empirical evidence.

This issue is truly a fundamental one, for Democritus explained everything else in terms of such atoms as real units in specific positions and motions in the void. So herein lies as well the foundation and roots of the issue of the structure of physical objects (whether they are as individuals a contin-

uum and so an actual unity, or composed of atoms and thus an actual multiplicity), of the types of motion that are possible, of the operation of the sense-organs and the intellect, of the types of definitions and explanations that are possible, and thus of the whole system of Democritus' thought over against that of Aristotle. The further implications of this fundamental issue will become more evident as we proceed and consider these other problems separately; but, for the time being, we might simply note that Democritus applied this explanation in terms of atomic units throughout his system with an extraordinary consistency, and Aristotle praised him for it.¹ The atom as the real unit was fundamental to and consistent with the whole system of Democritus. Thus the issue raised by Aristotle is a vitally important and critical one.

Furthermore, intimately involved in the question of what constitutes a real unit is the important question of the divisibility of physical objects, the question whether such division can be carried out indefinitely or not, whether it can be carried out until it reaches an infinite multitude of dimensionless points or must stop short of this. But it is precisely in connection with this question that a problem of interpretation arises, the problem of whether Democritus' atom is mathematically or intellectually as well as physically indivisible, with the majority of recent writers holding that

¹Gen. et Corr. 1.8, 324b35-325a1: ὁδῶ δὲ μάλιστα καὶ περὶ πάντων ἐνὶ λόγῳ διωρίκασι Λεύκιππος καὶ Δημόκριτος.

they were likely indivisible in both respects.² There is no disagreement on the fact that Democritus held his atoms to be physically indivisible, and so the current issue lies only with their mathematical indivisibility. And this question, as Sinnige rightly points out,³ is answered basically in terms of the philosophical heritage within which Democritus spelled out his answers.

²Much has been written on this problem. Among the most significant works are the following: Ingeborg Hammer-Jensen, "Demokrit und Platon" in Archiv für Geschichte der Philosophie, XXIII (1910), 92-105, 211-229; V. E. Alfieri, Atomos Idea: l'origine del concetto dell' atomo nel pensiero greco (Florence: Le Monnier, 1953); S. Luria, "Die Infinitesimaltheorie der antiken Atomisten" in Quellen und Studien zur Geschichte der Mathematik, Abteilung B, Band 2, Heft 2, 1932, pp. 106-185 (Luria contends that there are 'atoms' in two senses, that is, that there are 1) physically indivisible atoms and 2) 'atoms' which are theoretical parts of the physically indivisible atoms); Jürgen Mau, Zum Problem des Infinitesimalen bei den antiken Atomisten (Berlin: Akademie-Verlag, 1957); David J. Furley, Two Studies in the Greek Atomists: Study I, Indivisible Magnitudes; Study II, Aristotle and Epicurus on Voluntary Action (Princeton, New Jersey: Princeton University Press, 1967).

Beyond these Guthrie, History, II, 503-507, believes that the evidence points to the fact that the atoms are both physically and mathematically indivisible; Furley agrees. Gregory Vlastos (cited by both Guthrie and Furley, though not in print as nearly as I know) contends that the atoms are mathematically divisible. G. S. Kirk and J. E. Raven, The Presocratic Philosophers (Cambridge: University Press, 1960), p. 408, likewise indicate that they were divisible in thought, though not in fact. Theo Gerard Sinnige, Matter and Infinity in the Presocratic Schools and Plato (Assen: Van Gorcum and Company, 1968), holds that Democritus' theory was basically Ionian in character and was thus concerned with physical, not mathematical divisibility; he furthermore contends that the Eleatic context in which this question is raised is introduced by Aristotle in order to criticize Democritus; therefore, he would contend, it is misleading to rely on the context in Aristotle in attempting to determine Democritus' own answer to this most important question.

³Op. cit., especially pp. 164-167.

Any attempt to answer this question must come to grips with the account of Aristotle, for he is our chief witness to the teachings of Democritus in matters regarding the problems both of mathematical divisibility and of Democritus' philosophical heritage; and Aristotle's testimony is pivotal,⁴ if the question is to be answered with any sort of probability at all. At any rate, we may tentatively make some general remarks about Aristotle's account of Democritus' teaching on the matter of divisibility and indivisibility. There seems to be no doubt that Democritus' atoms were physically indivisible; Aristotle calls the atom *ἀπαθής* (Gen. et Corr. 1.8, 326a1); and the general agreement on this point is so wide that we may use this as our starting-point in the examination of Aristotle's account of Democritus with respect to mathematical divisibility. As we do, it will prove highly probable--any higher degree of certainty on this moot question does not seem possible--that Democritus held that his atoms were mathematically divisible, that physical division is largely an illusion (all atoms are and remain distinct); and so mathematical division, although it is conceivable, simply does not in fact apply to physical objects.

The Terminology

It will be helpful, before entering upon an examination

⁴Mau, op. cit., p. 24, seems quite right when he states: "Wenn wir dieser Frage von Aristoteles abweichen, dann wagen wir uns auf das Gebiet der reinen Konjektur."

of Aristotle's accounts and criticisms of Democritus, to consider some of the more essential terminology which was used by Democritus for his 'atoms' as true physical units. This will help us to clarify in a preliminary way the position of Democritus and to focus our attention on its uniqueness. Where both Aristotle and Democritus use a single term in different ways, there will be an attempt to indicate such essential differences.

First of all, there is, according to the witness of Plutarch, a usage of the term ἰδέα for an atom,⁵ emphasizing rightly the 'shape' of atoms, which, we shall see, is important for the structure of physical objects.⁶ Although this term may have been used by Democritus, Aristotle tends to avoid it in reference to the atoms of Democritus--likely because of its meaning in Plato--and prefers instead to use the term σχῆμα, by which he also translates Democritus' own term ὀυσμός.

⁵Plutarch *Adversus Colotem*, 1111A: εἶναι δὲ πάντα τὰς ἀτόμους, ἰδέας ὑπ' αὐτοῦ καλουμένας. This would give us the feminine form ἄτομος ἰδέα, 'undivided shape'. But, since Aristotle, as we shall see, regularly connected the adjective ἄτομος with a neuter noun, for the sake of consistency the neuter form ἄτομον will here be used to indicate the 'atom'.

⁶Compare Cyril Bailey, *The Greek Atomists and Epicurus* (reprint, New York: Russell and Russell, 1964), p. 118. The consideration of the importance of 'shape' will be taken up more fully in chapter three of this paper.

I shall in this paper be using the term 'physical object' to designate that external being which is confronted by the senses, and the term 'phenomenal object' to indicate that same object as we perceive it. Thus for Democritus the 'physical object' may be a mass of atoms and void, while the same object as phenomenal might be a continuous, hard, brown desk. This distinction between 'physical object' and 'phenomenal object' is of utmost importance in considering Democritus' teachings.

Now, aside from the emphasis on shape or form in the terminology, there are in Democritean usage several adjectives which indicate that the atom was a three-dimensional shape which was packed solid and full. Simplicius, for instance, gives witness to a fragment of Aristotle's work, On Democritus, in which the term *ναστόν* ('closely pressed and packed') is attributed to Democritus.⁷ Likewise, Democritus evidently also used the term *πλήρες* ('full') to indicate this same fullness and solidity;⁸ and Aristotle himself says that Democritus used this latter term to signify that which truly is, *τὸ ὄν*,⁹ and to indicate thereby one of his basic elements, *στοιχεῖον*.¹⁰ Thus Democritus' atom is to be taken as 'solidly full'.

There is another term with related significance which goes back at least as far as Democritus,¹¹ the term *δέν*; it was

⁷ Simplicii in Aristotelis de Caelo Commentaria, vol. VII of Commentaria in Aristotelem Graeca, ed. by I. L. Heiberg (Berlin: George Reimer, 1894), p. 295, line 5.

⁸ John Burnet, Early Greek Philosophy (reprinted in Cleveland and New York: World Publishing Company, 1957), p. 337, believes that Leucippus used it in this sense and that he had borrowed it from Melissus.

⁹ Meta. 4.5, 1009a28-29: οὗτος τὸ κενὸν καὶ τὸ πλήρες ὁμοίως καθ' ὅτις οὖν ὑπάρχειν μέρος, καίτοι τὸ μὲν ὄν τούτων εἶναι τὸ δὲ μὴ ὄν -- "He [Democritus] says that 'the empty' and 'the full' are likewise at any given part, and yet that one of these 'is' and the other 'is not'."

¹⁰ Meta. 1.4, 985b5: ὁ Δημόκριτος στοιχεῖα μὲν τὸ πλήρες καὶ τὸ κενὸν εἶναι.

¹¹ Kurt von Fritz, Philosophie und sprachlicher Ausdruck bei Demokrit, Plato und Aristoteles (Darmstadt: Wissenschaftliche Buchgesellschaft, 1963), p. 18, claims that the term goes back to Leucippus; Bailey, op. cit., p. 118, traces it back to Democritus.

obviously quite artificially and consciously created for its sheer contrast to οὐδέν, 'nothing'--a term for 'void' or 'empty space'. Thus, if δέν is to have any unique significance at all, it must be the direct contradictory to 'nothing', and so it must be that which is fully and simply a thing, pure matter, packed solid and full.

Furthermore, the very term 'element' (στοιχεῖον) is one that goes back to Democritus, as von Fritz remarks;¹² the term was used by Democritus in a sense noticeably more primitive than the meaning it has for Aristotle, in a sense that is much closer to that of the individual and distinct 'elements' of the alphabet. Aristotle's use of the letters of the alphabet to illustrate the shape, position, and placement of the atoms¹³ very likely goes back to Democritus himself, as the latter drew out this metaphor to illustrate, for one thing, the varying shapes that his elements were to have. Thus, in the light of the Democritean use of this term for the atomic unit, we may further safely attribute to the atoms of Democritus the fact that they, while distinct and separate from one another, differ quite specifically from one another in shape and are used in conjunction with one another to build physical objects.

¹²Op. cit., pp. 24-25.

στοιχεῖον for Aristotle is a primary constituent of things, which is in kind not divisible into another kind: ἐξ οὗ σύγκειται πρῶτον ἐνυπάρχοντος ἀδιαίρετου τῷ εἶδει εἰς ἕτερον εἶδος --Meta. 5.3, 1014a26-27; it is something whose continued bisection results only in something of the same kind, as water is only divisible into smaller bits of water.

¹³Meta. 1.4, 985b15-19.

Likewise, in this connection, von Fritz traces and expounds another Democritean term, this time one much more unique in Greek philosophy, *ρυσμός*; ¹⁴ its meaning may be taken to be roughly 'form' or 'shape'. The use of this term in Herodotus 5.58 for the 'shape' of letters is very interesting for its appropriateness to the use of *στοιχεῖον*, though it is less metaphoric than the latter. Its use is quite appropriate to the atoms of Democritus, for it does not signify the 'perceptible form'--as does *εἶδος*--but the 'objective law or principle of the atom's form' as it realizes itself in its own motion, quite apart from any outside influence; it is a unique combination of form and movement. And this is the term which Aristotle regularly translates or interprets as *σχῆμα*, or 'shape'; ¹⁵ and, in so doing, he has abstracted from it--as he does also with *τροπή* and *διαθιγῆ*--the idea of motion; he has taken it in the isolation of an instant and thus proposes to examine it simply inasmuch as it is a 'shape', or, if you will, as a permanent physical unit. ¹⁶

Finally, there is the term most usually connected with

¹⁴Op. cit., pp. 25-26.

¹⁵Meta. 1.4, 985b15: *τούτων δὲ ὁ μὲν ρυσμός σχῆμα ἐστίν.*

¹⁶This is not to imply that Aristotle does an injustice to Democritus' atom in this respect; he certainly does recognize and deal with the aspect of its motion. Indeed, immediately following his exposition of *ρυσμός* as *σχῆμα*, he raises the question of motion: *περὶ δὲ κινήσεως, ὅθεν ἢ πῶς ὑπάρξει τοῖς αἰῶσι, καὶ οὗτοι . . . ῥηθῆναι ἀρεῖσθαι* --Meta. 1.4, 985b19-20. But we shall be dealing with that question separately in the second and third chapters.

the name and teaching of Democritus--'the atom' (ἄτομον). It indicates not only that Democritus' unit is and remains 'uncut', but also that it is at least physically indivisible.¹⁷ Aristotle uses the term quite often of Democritus' unit,¹⁸ but he usually distinguishes the term as it applies to Democritus' atoms from his own meaning of that term by adding the noun σῶμα or μέγεθος or both to this adjective.¹⁹ And this usage of the term ἄτομον, Bailey feels, can be traced all the way back to Leucippus,²⁰ and it is in fact attested by the fragments of Democritus.²¹

Thus, in the light of the above Democritean terminology, we may reasonably give a preliminary description of Democritus' physical unit. It has a given shape or form (ἰδέα, ρυομός);

¹⁷It is described by Aristotle as ἀπαθείς (Gen. et Corr. 1.8, 326a1); see also above, p. 16.

¹⁸See H. Bonitz, Index Aristotelicus (Graz: Akademische Druck- und Verlagsanstalt, reprinted 1955), p. 120. There may be implicit here a certain amount of 'question-begging' on the matter of mathematical divisibility in that Bonitz' list of uses of this term as applied to the atoms of Democritus is entered under the heading 'mathematice'.

¹⁹For example, Physics 8.9, 265b29, Gen. et Corr. 1.2, 315b29, and Caelo 3.4, 303a21. The Democritean terminology (ἰδέα, ρυομός, πλήρες, ναστόν) certainly indicates that this is a justified addition.

²⁰Op. cit., p. 73.

²¹It is in a fragment quoted by Sextus Empiricus, fragment 68B9 in Hermann Diels and Walther Kranz, Die Fragmente der Vorsokratiker, 3 vols., (Berlin: Weidmannsche Verlagsbuchhandlung, 1960-1961).

Guthrie, History, II, 395, note 2, seems to have overlooked that passage and asserts that ἄτομος in its feminine or neuter form "does not occur in any actual fragment of Democritus."

various atoms have a variety of shapes and are used in the construction of physical objects (στοιχεῖον); these shapes are not simply outlines, but are solids and fully packed (πλήρες, वास्तव), and thus have extension and are in fact minute bodies; they are, furthermore, the simple and absolute antitheses to 'void', and, as such, are 'what is' (δέν, τὸ ὄν); they are and remain undivided and are physically indivisible (ἄτομον).

It may at this point be both appropriate and helpful to indicate briefly Aristotle's own use and application of the term ἄτομον, not only because it will help clarify and keep distinct the teachings of these two men on the matter of divisibility,²² but also because Aristotle's own use of that term will indicate the major areas in which he criticizes the teaching of Democritus on what is the true physical unit.

Bonitz, evidently quite correctly, distinguishes two fundamental meanings of the term ἄτομον for Aristotle.²³ First of all, there is a sense in which Aristotle uses the term in reference to physical division. It is Aristotle's position that every magnitude is constantly divisible into magnitudes;²⁴ and thus the only things that can remain undivided in this

²²Sinnige, *op. cit.*, p. 145, conflates Aristotle's meaning with that of Democritus, and thus he makes nonsense of it; he defines it, as used by Aristotle of Democritus' atoms, as "indivisible magnitudes which are the result of a process of infinite division." (Italics mine.)

²³*Op. cit.*, p. 120, under ἄτομος.

²⁴*Physics* 6.2, 232a23-25: πᾶν μέγεθος εἰς μεγέθη διαιρετόν (δεδείχεται γὰρ ὅτι ἀδύνατον ἐξ ἀτόμων εἶναι τι συνεχές, μέγεθος δ' ἐστὶν ἅπαν συνεχές).

sense are the instant in time, the 'instantaneous now', and the dimensionless point.²⁵ In this sense the ἄτομον is not a 'unit', for one can never by conjoining such ἄτομα produce either an extent of time or an actual physical magnitude; it is the point at which one divides something and not that into which one actually divides something.

In this respect, as we shall see, Aristotle's criticism of Democritus' ἄτομον will be that as a magnitude it will reasonably be further divisible, that physical division can only end in a 'point', which is no unit at all.

Aristotle's second fundamental use of the term ἄτομον is a logical one. In this sense the term refers to individual members of a species;²⁶ these ἄτομα are described by Aristotle in the Categories as simple units and numerically one, and they are that of which genus and species are predicated.²⁷ And this sense of the term is also carried through by Aristotle

²⁵ Caelo 3.1, 300a14: τὸ γὰρ νῦν τὸ ἄτομον οἷον στιγμή γραμμῆς ἐστίν--"for the indivisible 'now' is like the point on a line." Here Aristotle makes the same point about the 'indivisible now' as he makes in On Generation and Corruption 1.2 about the 'indivisible point', that is, that continuous time, like a continuous magnitude, will be annihilated if one could succeed in carrying out the division into 'nows'.

²⁶ The term is also used in other senses, for example, of species which are not capable of further division, but none of these other usages seem critical or important to the issue at hand.

²⁷ 2, 1b6-7: ἀπλῶς δὲ τὰ ἄτομα καὶ ἐν ἀριθμῷ. Also 5, 3a38-39: τὸ μὲν εἶδος κατὰ τοῦ ἀτόμου κατηγορεῖται, τὸ δὲ γένος καὶ κατὰ τοῦ εἶδους καὶ κατὰ τοῦ ἀτόμου. Such individual things, as ἄτομα, are never predicated of a subject, though genus and species are predicated of them.

in the Metaphysics.²⁸ Thus, for Aristotle, the real ἅτομα in this universe are basically the primary substances, the individual objects such as Socrates; it is the individual which is numerically indivisible: ἀριθμῷ μὲν οὖν τὸ καθ' ἑκάστον ἀδι- αίρετον (Meta. 10.1, 1052a31-32).

With regard to this meaning of the term ἅτομον in Aristotle, Aristotle's criticism of the position of Democritus is that, since Democritus' ἅτομον remains an actual unit, he denies the unity of that which we perceive to be a unit, the individual primary substances. This criticism, as we shall see in the second chapter of this paper, applies as well to the positing of a void, inasmuch as the void in an object is that which actually separates it and keeps it from being a continuous unit.

Democritus Posits the Atom as the Unit

But, before elaborating on Aristotle's criticisms, it will be necessary to look more closely at the teachings of Democritus as they apply specifically to this issue of what

²⁸E.g., 3.3, 999a15-16: ἐκ μὲν οὖν τούτων μᾶλλον φαίνεται τὰ ἐπὶ τῶν ἀτόμων κατηγορούμενα ἀρχαὶ εἶναι τῶν γένων-- "and so of these that which is predicated of individuals seems more of a principle than the genera." See also W. D. Ross, Aristotle's Metaphysics, 2 vols. (Oxford: Clarendon Press, 1958), I, 224, 237; II, 302. Other passages in which the term is so used are Meta. 3.1, 995b29; 3.3, 998b16, 999a12; 10.8, 1058a18, 19, 20.

I shall not be entering into the ontological significance of an individual patch of white which is present in an object. For a recent discussion of that question see James Duerlinger, "Predication and Inherence in Aristotle's Categories" in Phronesis XV, 2 (1970), 179-203. Such individuals seem to depend for their existence on primary substances.

constitutes the real unit in the world of physical objects.

First of all, it seems quite evident from Aristotle--and we have no real reason for rejecting his witness²⁹-- that Democritus' positing of the atoms had its basis in empirical evidence, even though in some respects he had made some concessions to Eleatic arguments; his theory was one which, he felt, did not do away with the validity of appearances.

This empirical foundation is indicated by Aristotle in his Metaphysics, 4.5, 1009a22-30.³⁰ There Aristotle asserts that Democritus, among others, came to his view "as a result of what is perceived" (ἐκ τῶν αἰσθητῶν --1009a23), as a result of the appearance of contraries in the same phenomenal object (1009a23-25). But such contraries did not lead Democritus to deny the witness of the senses altogether, but rather to claim that both such contraries are true and are in fact due to the existence of atoms and void at any given part of the object (1009a25-30); atoms and void then are posited because of empirical evidence and are intended as well to explain empirical

²⁹Still Paul Natorp, Forschungen zur Geschichte des Erkenntnisproblems im Altertum (Hildesheim: Georg Olms Verlagsbuchhandlung, reprinted 1965), p. 165, note 1, would reject it; he claims, "von aller Sinneswahrnehmung ausdrücklich wird die γνῶσις γνῶμη unterschieden."

But there is no real discrepancy between the witness of Aristotle and that of Sextus Empiricus on this point; Aristotle is quite justified in his remarks on the empirical foundations of atomism, as will be shown in chapter three of this paper.

³⁰It is later in the same chapter, at 1009b13-15 (τὸ φαινόμενον κατὰ τὴν αἴσθησιν ἐξ ἀνάγκης ἀληθὲς εἶναι φασιν) that Aristotle witnesses to the 'truth' of sense-perception for Democritus.

facts.

The empirical foundations of Democritus' atomism are again taken up in On Generation and Corruption 1.2; quite early in that chapter the Democritean dictum regarding truth in appearances is mentioned by Aristotle (315b9-10) precisely in connection with the atoms (τὰ σχήματα--315b11), the appearance of contraries in a physical object (315b12), and the construction of physical objects out of atoms, which in this respect act just like the letters which make up words (315b14-15). A number of lines later in this same chapter (316a5-14) Aristotle indicates two basic approaches to the positing of atomic bodies, the approach through logic and the approach through observation and the study of nature:³¹

"The reason why we have not the power to comprehend the admitted facts is our lack of experience[τὴν ἀπειρίαν]. Hence those who have lived in a more intimate communion with the phenomena of nature are better able to lay down such principles as can be connected together and cover a wide field; those, on the other hand, who indulge in long discussions without taking the facts into account are more easily detected as men of narrow views. One can see, too, from this the great difference which exists between those whose researches are based on the phenomenon of nature and those who inquire by a dialectical method. For on the subject of atomic magnitudes one school maintains their existence on the ground that otherwise the 'ideal triangle' will be many, while Democritus would appear to have been convinced by arguments germane to the subject and founded on the study of nature."

Democritus is obviously put into the group of those who formu-

³¹The translation is that of E. S. Forster in Aristotle On Sophistical Refutations, On Coming-to-be and Passing-away, On the Cosmos, edited by E. S. Forster and D. J. Furley (Cambridge: Harvard University Press, 1965), pp. 175, 177.

lated their theories on the basis of a study of the natural objects of the world; and what follows in the chapter is an account of Democritus' reasons for positing indivisible bodies.

Thus precisely the indivisibility of these atoms, Aristotle indicates, was posited because of empirical evidence. In the discussion of divisibility that follows in the chapter (316a14-317a31) a physical object with extension is in question (σῶμα τι εἶναι καὶ μέγεθος --316a15); and exactly where the argument is to lead to atomic bodies, the term for division (ἡ θρόψις --316b30) has strong physical and empirical overtones; and, indeed, the reason given for positing atomic bodies is to avoid reducing the physical object to a total illusion: καὶ τὸ πᾶν δὲ οὐδὲν ἀλλ' ἡ φαινόμενον --316a29; also 316b30-32: οὔτε ἅμα οἶδόν τε διαιρεθῆναι κατὰ πᾶν σημεῖον (οὐ γὰρ δυνατόν) ἀλλὰ μέχρι του.

Again, in On Generation and Corruption 1.8, the empirical foundation of the indivisible atom is in evidence. At the beginning of the chapter Aristotle remarks that Leucippus and Democritus made their principle accord with nature just as it is;³² and again the reason given for the indivisibility of the atoms is one apparently based on sense-experience: larger objects are broken up (θραύεται, compare θρόψις at 316b31) more readily than small ones (326a26). Also in this chapter Aristotle makes the statement: "But Leucippus thought that he had accounts which agree with sense-perception and do not do

³²325a1-2: ἀρχὴν ποιησάμενοι κατὰ φύσιν ἥπερ ἐστίν.

away with generation or corruption or with the movement and multitude of things."³³ It was thus a consideration of the phenomenal world that led Democritus to his theory of indivisibles, a theory which, incidentally, also involved accounts which did not utterly deny the validity of sense-perception, but were in agreement with it.

Now, in addition to considerations of empirical evidence, the other major factor which led Leucippus and Democritus to posit atomic bodies was the arguments of the Eleatics on division. There is a hint of this in On Generation and Corruption 1.8, 325a1-29; there first the fact that Leucippus and Democritus made their principle accord with nature is mentioned with praise; immediately thereupon Aristotle presents a summary and critique of general Eleatic teaching (325a2-23), including their teaching of the necessary unity and impassibility (ἀκίνητον) of that which is (τὸ ὄν), the lack of void and hence of motion, and including especially the argument: "For if [what is] is everywhere divided, nothing is one, and so there are not even many things, but the sum total is empty."³⁴ This reasoning, Aristotle says, brought them to disregard sense-perception and simply to follow their reasoning, and brought them to the point of madness of denying any real

³³1.8, 325a23-25: Λεύκιππος δ' ἔχειν φήθη λόγους οἵτινες πρὸς τὴν αἰσθησὶν ὁμολογούμενα λέγοντες οὐκ ἀναιρήσουσιν οὔτε γένεσιν οὔτε φθορὰν οὔτε κίνησιν καὶ τὸ πλῆθος τῶν ὄντων.

³⁴325a8-9: εἰ μὲν γὰρ πάντα διαιρετόν, οὐθὲν εἶναι ἔν, ὥστε οὐδὲ πολλὰ, ἀλλὰ κενὸν τὸ ὅλον.

difference between ice and fire. Aristotle then goes on to mention the arguments of Leucippus in agreement with sense-perception (325a23-25, cited in note 33, above). The extremely strong implication is that Leucippus (and Democritus) formulated their teaching as in some sense a reply to the Eleatic position, for, Aristotle says, Democritus held that what really exists is an absolute plenum (325a28-29: τὸ γὰρ κυρίως ὄν ἀμπληθὲς ὄν).

And it is evidently to this reply that Aristotle refers in Physics 1.3, 187a1-3, when he says: "But some gave in to both arguments, both to the argument that everything is one, if 'what is' has [only] one meaning [an absolute one], and to the argument from 'dichotomy', replying to the former that 'what is not' exists, and to the latter by positing atomic magnitudes."³⁵ But there is no further mention in this passage as to what this argument from 'dichotomy' is.

One possible identification of this argument from 'dichotomy' is the first of Zeno's paradoxes described at Physics 6.9, 239b11-14, that one cannot move because, before reaching one's goal, one must first reach the half-way point, and, before reaching that, one must first go half that distance, and then first half the latter distance, ad infinitum. This argu-

³⁵ἐνιοὶ δ' ἐνέδοσαν τοῖς λόγοις ἀμφοτέροις, τῷ μὲν ὅτι πάντα ἓν, εἰ τὸ ὄν ἓν σημαίνει, ὅτι ἔστι τὸ μὴ ὄν, τῷ δὲ ἐκ τῆς διχοτομίας, ἅτομα ποιήσαντες μεγέθη. For recent agreement identifying the ἐνιοὶ with the atomists see Cherniss, op. cit., p. 75, note 303; David J. Furley, op. cit., p. 81; W. D. Ross, Aristotle's Physics (Oxford: Clarendon Press, 1955), p. 481.

ment is twice referred to by Aristotle as involving 'dichotomy' (τὸ διχοτομεῖν--239b18-19; and τῇ διχοτομίᾳ --239b22).

But a more likely candidate is the argument identified by Furley as 'Argument A' of Zeno;³⁶ it seems much more appropriate to the account given by Aristotle in On Generation and Corruption 1.8, especially 325a8-9, and to the argument as outlined in the same work at 1.2. The argument is roughly this: if 'what is' is many, it must be both infinitely small and infinitely large. If it has magnitude, it may be infinitely bisected into parts with magnitude, and an infinite number of finite magnitudes is infinitely large; but, if it consists of indivisible units, what is indivisible has no magnitude, and so the unit has no magnitude.

This argument of Zeno's depends for its force, as Furley himself points out,³⁷ on the practical applicability of mathematical division to physical objects, one which results in physical division; otherwise Zeno's argument might apply as well to any Eleatic being with magnitude; and it depends as well on the complete and simultaneous exhaustion of this division. It is Zeno's point that the practical application of divisibility everywhere raises specific difficulties with phenomena: if 'what is' is everywhere divided, then either the whole object is reduced to 'nothings' and is nothing but a sheer

³⁶Op. cit., pp. 63-69. This is substantially the same one that Ross, Physics, pp. 479-480, suggests.

³⁷Op. cit., pp. 67-68. Furley further states that Zeno was responding to Anaxagoras in particular (p. 76).

illusion, or each magnitude is infinitely large--and this too is directly contrary to empirical evidence.

Democritus basically accepted these Eleatic consequences for the phenomenal object and agreed to its illusory character. But his foundation in the study of nature would not let him agree to the actual, physical application of such division to the physical object.

So it seems evident that it is precisely the impossibility of physically carrying out mathematical divisibility on the physical object that Democritus posits as a response to Zeno's dilemma. The physical object only seems to be continuous, he would say; but it actually is and remains divided into atoms; any apparent division of that object is in fact illusory, for it is not continuous in the first place. But the atoms themselves, although they have actual bulk and are full (πλήρες, παμπληρές, ναστόν), are and remain 'uncut'; mathematical division has no practical application to the atoms; division there may be conceived in that one might mentally trace lines on atoms at which these atoms may be mentally divided. But such division cannot be physically carried out. That this was likely the nature of Democritus' response will become more evident as we further examine Aristotle's account of Democritus' teachings on the atom.

The major passage in which Aristotle accounts for Democritus' response to Zeno's dilemma is to be found at On Generation and Corruption 1.2, more specifically at 316a14-317a31.

It is precisely immediately prior to this passage that Democritus is praised for his being persuaded by arguments "founded on the study of nature" (φυσικοῖς λόγοις --316a13) rather than being simply led by a "dialectical method" (λογικῶς σκοποῦντες--316a11); and what follows this purports to illustrate exactly that point--more consideration of the study of nature than of logical argumentation (316a14).

It will be helpful first to sketch generally the argument of the passage as a whole (316a14-317a31), including as well Aristotle's criticisms--and thus see the passage as a whole--and then go on to take up the individual parts of the passage, reserving Aristotle's criticisms for separate consideration later.

The passage begins with what amounts to a recapitulation and elaboration of what Furley has designated as Zeno's 'Argument A' (316a14-316b9), along with a special variation supplied by Aristotle (316b9-14).³⁸ Then follows what is evidently Democritus' response to this argument, that since a physical object cannot be composed of dimensionless points, there must be undivided bodies with size; but this, Aristotle says, involves difficulties taken up elsewhere (316b14-18). So Aristotle says that the problem will have to be examined in a new light; and this he does by introducing the concepts of 'potency' and 'act' to help clarify the situation, this time

³⁸Furley, op. cit., pp. 84-85, and Ross, Physics, p. 480, both identify this 'Argument A' with 'the argument from dichotomy'.

reaffirming the infinite divisibility of any magnitude into smaller magnitudes (316b18-29). Thereupon he reintroduces the argument for atomic magnitudes, stating that, since physical division cannot go on forever, it must end, in order to preserve the phenomenon of generation and corruption (316b29-317a1); thus, Aristotle says, the position of the atomists rests on a logical error, for they have taken the 'everywhere' in 'divisible everywhere' collectively instead of distributively, only in the impossible sense of 'everywhere at once', but have overlooked the possible sense of 'at any of all possible points' (317a1-12). Thus there is no division into what is indivisible, but only into increasingly smaller magnitudes (317a12-17). But generation and corruption are events which happen to the object as a whole, while the atomists claim that what happens to all--no more or less--of the physical object (that is, shifts of the atoms in that physical object) is alteration (317a17-31).

Thus, what we have in the first portion (316a14-b9) of this whole passage is basically Zeno's³⁹ argument on the divi-

³⁹Since we possess neither Zeno's argument intact nor any other independent witness to Democritus' formulation of it, it is impossible to distinguish precisely the contribution of each of these three authors to its presentation in Aristotle. But that is not of major importance; it is generally agreed that this was essentially the argument considered by Democritus and the one to which he responded by positing atomic magnitudes. Cherniss, op. cit., p. 113, expresses some hesitancy, but admits that it is consistent with other remarks by Aristotle about Leucippus and Democritus. Even Sinnige, op. cit., who is quite concerned to separate Democritus from the Eleatic tradition, admits Eleatic influence on Democritus.

sion of any magnitude into dimensionless points, as received and considered by Democritus and reformulated by Aristotle. The basic argument is clear enough and is stated at the outset: ". . . if one should posit that any body with magnitude is divisible everywhere, and that this is possible. For what will there be which escapes division?"⁴⁰ If it is divisible everywhere, the object will be constructed out of 'nothings' and be nothing but an appearance (ἐκ μηδενός . . . καὶ τὸ πᾶν δὲ οὐδὲν ἄλλ' ἢ φαινόμενον --316a28-29), or it will consist of dimensionless points which again can constitute no magnitude (316a29-30). Admit division everywhere, Democritus says, and there will be no physical object at all.

Thus far the argument as considered by Democritus has placed strong emphasis on the actual, physical carrying out of the division and on the difficulties engendered by it.⁴¹ Now Aristotle introduces his own variation of the difficulty (316b9-14), in which he considers the object as divided everywhere in potency (πάντη ἄρα διήρηται δυνάμει --316b11-12). Even so, Aristotle says, the same difficulty is encountered; nothing is left but the (points of) division: τί οὖν ἔστι παρὰ τὴν διαίρεσιν; --316b12. The physical object cannot be constructed out of these nor be dissolved into them, for there

⁴⁰316a15-17: εἴ τις θέσῃ σῶμα τι εἶναι καὶ μέγεθος πάντη διαίρετόν, καὶ τοῦτο δυνατόν. τί γὰρ ἔσται ὅπερ τὴν διαίρεσιν διαφεύγει;

⁴¹One might note: καὶ εἰ τοῦτο γένοιτο (316a19); ἂν διαίρεσθῇ (316a21); διηρήσθω (316a24); διηρημένον (316a25)-- all of which stress the actual carrying out of the division.

is no way in which one can actually separate out such points or qualities from continuous extension. Also, in the process, Aristotle has already made some progress toward answering the difficulty by hinting that such an infinite division may be reached in potency, and that one cannot divide a magnitude into points.

This brings us to what is apparently Democritus' response to the difficulty (316b14-16), along with Aristotle's remark about other difficulties which this response generates (316b16-18). The argument in which the response of Democritus is formulated is an enthymeme: "And so, if indeed magnitudes cannot be constructed out of contacts or points, (and if magnitudes must be constructed out of something with magnitude), it is necessary that there be undivided bodies which are still magnitudes."⁴²

Furley claims that Democritus' response was also conceived by him as being a solution, something which would block the argument of Zeno, namely, a conceptually indivisible magnitude.⁴³ But it is a body with magnitude that Democritus claims is indivisible, not a sheer magnitude without any substance to it (although even the latter would still fail to block Zeno's

⁴² ὥστ' εἴπερ ἀδύνατον ἐξ ἀφῶν ἢ στιγμῶν εἶναι τὰ μεγέθη, ἀνάγκη εἶναι σώματα ἀδιαίρετα καὶ μεγέθη.

I have taken ἀδιαίρετα as 'undivided', in the sense that what it qualifies remains physically indivisible, as that which has no proper parts into which it can in fact be further divided. The use of 'magnitudes' here certainly implies that what remains after the physical division has stopped is at least conceptually or mathematically divisible.

⁴³ Op. cit., pp. 85-86.

argument, which would apparently hold for any magnitude); and how Democritus could have followed Zeno's arguments at all and supposed that such a body with magnitude is conceptually indivisible is itself beyond comprehension. Moreover, those atomic bodies of Democritus have specific shapes--angular, round, straight-edged (Physics 1.5, 188a25-26)--and they do come in various sizes (Caelo 3.4, 303a15); and to suppose that such atoms could be conceptually and mathematically indivisible seems to be stretching things too far. Thus Furley seems to be wrong about their 'conceptual indivisibility';⁴⁴ but his contention will be discussed a little more fully later.

The physical object, Democritus felt, cannot itself be a sheer illusion, really reduced to nothing at all; he was compelled by the study of nature rather than by dialectic, by theory. His study of nature, his consideration for natural phenomena, forced him to reject 'divisible everywhere'; so he rejected it where it counted as far as he was concerned, in the sense of the physical division of the physical object. He saw no way out of the difficulty but to separate the two kinds of division, the physical from the conceptual.

Zeno's argument, along with the appearance of contraries in the same phenomenal object, may well have convinced Democritus that the phenomenal object is not after all the physical object as it really is. The phenomenal object appears contin-

⁴⁴This, as we shall see later, is further supported at 316b29-32, where Democritus' response to 'divisibility everywhere' is repeated.

uous; and conceptual division may well apply to it without affecting the physical object at all. On the other hand, as far as the atomic magnitude is concerned, Democritus apparently simply denied that it had any practical application there, and so he rendered it, he felt, totally innocuous. And he might very well have said that conceptual division is only that--conceptual, that it exists only by convention (νόμος).

The next section in this passage (316b18-27) is a difficult one as it stands in the text. If we take the text as it is, one must admit that here Aristotle is doing two things. First of all, he is doing precisely what he says he is doing; he is reviewing the difficulty about 'division everywhere'--a difficulty which led to the positing of atomic magnitudes--from the beginning: διὸ πάλιν ἐξ ἀρχῆς τὴν ἀπορίαν λεκτέον -- 316b18-19. As was the case with his previous presentation of this difficulty, he begins with a perceptible body which is divisible (316b19) and ends with the body vanishing into nothing (316b25-27).

But there is then a problem with the interpretation of this passage, for it is generally taken to be Democritus' own restatement of the difficulty with division, a difficulty which led him to posit atoms. And this is basically the position of Verdenius and Waszink; for they take this whole passage from 316b18 to 34 to be a Democritean argument for atoms; but in interpreting the passage in that way they rightly feel obliged to delete significant portions of the text--all those

dealing with 'potency' and 'act'.⁴⁵ But such deletions should only be used as a last resort. Sinnige too takes the passage through 316b34, along with this section--apparently without deleting the references to 'potency' and 'act'--as a unit and concludes that Aristotle is only demonstrating the existence of atoms in the framework of his own thinking.⁴⁶ But this too is unsatisfactory, for the empirical considerations of 316b29-34 do in fact seem to be those of Democritus.⁴⁷ Furley admits that it is basically Aristotle's reformulation of the difficulty, but that Democritus might well agree with him;⁴⁸ but it is pure speculation as to what Democritus might do with the 'potency' and 'act' which is introduced in the passage. Thus the only reasonable course to take is to assume that 316b18-27 is, for one thing, a summary statement by Aristotle of the difficulty.

⁴⁵W. J. Verdenius and J. H. Waszink, Aristotle On Coming-to-be and Passing-away: Some comments (Leiden: E. J. Brill, 1966), pp. 11-14. This is really the only reasonable alternative if the passage represents only Democritus' analysis of the difficulty.

⁴⁶Op. cit., p. 147.

⁴⁷See H. H. Joachim, Aristotle On Coming-to-be and Passing-away (Reprint, Hildesheim and New York: Georg Olms Verlag, 1970), p. 84. Joachim does not explicitly say that 316b18-27 is Aristotle's reformulation of the difficulty about division, but he seems to imply it. If he does in fact intend that, then I believe that he is right.

⁴⁸Op. cit., pp. 90-91. He also claims that Aristotle is introducing 'potency' and 'act' to show that they cannot solve the problem; but, as we shall see, they are precisely the means by which a solution to the problem is reached.

But it is obviously more than that. Aristotle is not merely restating the difficulty, he is also taking us a step closer to its solution. He had already brought us the first step of the way to a solution at 316b9-14, where he had introduced 'potential division everywhere', and pointed out that one cannot actually divide a magnitude into points. He now takes us the second step toward a solution by using 'potency' and 'act' to show that there are two distinct meanings for $\pi\acute{\alpha}\nu\tau\eta$.

But, before beginning an analysis of Aristotle's reasoning here, it will be necessary to clarify the meanings of $\delta\iota\alpha\iota\rho\epsilon\tau\acute{o}\varsigma$ and $\acute{\alpha}\delta\iota\alpha\iota\rho\epsilon\tau\acute{o}\varsigma$ in this passage; these apparently cause some obscurity.⁴⁹ The difficulty is noticed immediately in the first sentence, where a magnitude is said to be $\acute{\alpha}\delta\iota\alpha\iota\rho\epsilon\tau\acute{o}\nu$ at any point in actuality; if $\acute{\alpha}\delta\iota\alpha\iota\rho\epsilon\tau\acute{o}\nu$ there means 'indivisible', either the formulation belongs to Democritus and not to Aristotle, and one must then attribute a distinction between 'potency' and 'act' to Democritus; or Aristotle himself believes that there is some point at which a magnitude is not divisible. Neither alternative is acceptable.⁵⁰ Furthermore, the disjunction ($\text{o}\acute{\upsilon}\chi \dots \acute{\alpha}\mu\alpha \dots \acute{\epsilon}\nu\tau\epsilon\lambda\epsilon\chi\epsilon\acute{\iota}\varsigma, \acute{\alpha}\delta\iota\alpha\iota\rho\epsilon\tau\acute{o}\nu$ καὶ διηρημένον--316b23-24) seems to support the meaning 'undi-

⁴⁹Joachim, *op. cit.*, p. 83, recognizes the problem, for instance, in the conjunction of $\delta\upsilon\nu\acute{\alpha}\mu\iota$ with $\delta\iota\alpha\iota\rho\epsilon\tau\acute{o}\nu$. But his solution--to take $\delta\upsilon\nu\acute{\alpha}\mu\iota$ more closely with $\acute{\epsilon}\acute{\iota}\nu\alpha\iota$ --does not really solve the problem.

⁵⁰Hence Verdenius and Waszink felt justified in excising portions of the text.

vided'. And so, in this analysis, διαίρετός and ἀδιαίρετος -- especially when qualified by δύναμις -- will be taken in the sense of 'divided' and 'undivided'.⁵¹ This has the advantage of making sense of the passage as a whole and of making that sense more apparent.

The difficulty, Aristotle strongly implies at 316b19-27 already, with 'divisible everywhere' is that 'everywhere' has two distinct meanings. These two meanings are distinguished and specified in the first two sentences of the passage: τὸ μὲν . . . καθ' ὅτι οὖν σημειῖον. τὸ δ' . . . ἅμα πάντῃ (316b19-22). And the concepts of 'potency' and 'act' are applied to both meanings to show that they are indeed different. The first meaning of πάντῃ is καθ' ὅτι οὖν σημειῖον, 'at any of all its points'; and, by applying 'potency' and 'act' to this meaning, Aristotle shows that there is absolutely no difficulty engendered by it at all (οὐδὲν ἄτοκον -- 316b20); indeed, a magnitude may be both divided and undivided at any point, as long as the first applies potentially and the latter actually.

⁵¹ Compare Liddell, Scott, Jones, McKenzie, Greek English Lexicon under 'ἀδιαίρετος, I' and 'διαίρετός, I'; both 'divided' and 'undivided' have at least some precedent in Aristotle. The transfer from one meaning to the other is quite easy in Aristotle, because before an object is 'actually divided' it must be 'potentially divided', that is, 'divisible'.

Thus δύναμις διαίρετόν, which is frequently translated as 'potentially divisible'; that is, 'able to be divisible', which at best is redundant, simply makes better sense as 'potentially divided' or 'divisible'.

This view has even more support when one considers that Aristotle himself refers specifically to the ambiguity of this word, ἀδιαίρετος, in On the Soul 3.6, 430b6, where he says: τὸ δ' ἀδιαίρετον ἐπεὶ δι' ἧς ἢ δύναμις ἢ ἐνεργείῃ.

Indeed, the whole difficulty with 'divisible everywhere' is engendered by the second meaning of $\pi\acute{\alpha}\nu\tau\eta$, $\acute{\alpha}\mu\alpha\ \pi\acute{\alpha}\nu\tau\eta$ --'at all its points at once'. That meaning does not even seem to apply 'potentially', much less 'actually'; for, if it did apply 'potentially', that potentiality might be actualized: $\epsilon\acute{\iota}\ \gamma\acute{\alpha}\rho\ \delta\acute{\upsilon}\nu\alpha\tau\omicron\nu,\ \kappa\acute{\alpha}\nu\ \gamma\acute{\epsilon}\nu\omicron\iota\tau\omicron$ --316b23. But that potency is one which cannot be actualized in such a way that the magnitude remains both undivided and divided (for these are contradictions), so as to save the magnitude from annihilation: $\omicron\acute{\upsilon}\chi\ \omega\sigma\tau\epsilon\ \acute{\alpha}\mu\alpha\ \epsilon\acute{\iota}\nu\alpha\iota\ \acute{\alpha}\mu\phi\omega\ \acute{\epsilon}\nu\tau\epsilon\lambda\epsilon\chi\epsilon\acute{\iota}\varsigma,\ \acute{\alpha}\delta\iota\alpha\acute{\iota}\rho\epsilon\tau\omicron\nu\ \kappa\alpha\acute{\iota}\ \delta\iota\eta\rho\eta\mu\acute{\epsilon}\nu\omicron\nu$ --316b23-24. (The only sense in which the potency $\pi\acute{\alpha}\nu\tau\eta\ \delta\iota\alpha\acute{\iota}\rho\epsilon\tau\omicron\nu$ can be actualized is the first sense of 'at any point': $\acute{\alpha}\lambda\lambda'\ \delta\iota\eta\rho\eta\mu\acute{\epsilon}\nu\omicron\nu\ \kappa\alpha\theta'\ \acute{\omicron}\tau\iota\omicron\upsilon\nu\ \sigma\eta\mu\epsilon\acute{\iota}\omicron\nu$ --316b24-25.) Thus it is more precisely $\acute{\alpha}\mu\alpha\ \pi\acute{\alpha}\nu\tau\eta\ \delta\iota\alpha\acute{\iota}\rho\epsilon\tau\omicron\nu$ which raises the difficulty that was so puzzling at 316a14-b9; and this is what reduces the body to nothing and seems to force us to reconstruct it out of points or 'nothings'; this is what was not possible (316b25-27); and the application of 'potency' and 'act' have made this quite evident.

This brings us to another statement of the problem of 'divisible everywhere' and Democritus' response by positing atomic magnitudes (316b28-34).⁵² In the previous statement of the problem and Democritus' response the division was viewed as complete and then ruled impossible; now the problem is

⁵²Joachim, *op. cit.*, p. 84, specifically identifies this as reproducing "the experiential basis of the Atomists' theory."

viewed from a different vantage point--before the division is actually completed. It is evident that an object is divided into constantly smaller and distinct magnitudes (316b28-29). But, Democritus claims, this infinite division cannot in fact be carried out to its end, nor can it actually take place at all the points of the object (note that Democritus uses κατὰ πᾶν σημεῖον in contrast to Aristotle's καθ' ὅτι οὖν σημεῖον). Thus actual division must only go to a certain magnitude (316b29-32), and so there must necessarily be undivided magnitudes (ἄτομα μεγέθη) which make up the physical object; and generation and corruption will take place by the separation and association of these atoms (316b32-34).

It is noteworthy that in the above passage there is a strong emphasis on physical division. The introduction of the term ἡ ἐρώψις (316b30)⁵³ contributes noticeably to this emphasis. Furthermore, the statement that a magnitude cannot be divided at all its points (316b31) seems to admit that there are points on it at which it cannot in fact be divided. Thus all of this as well argues against Furley's contention that the atom of Democritus is conceptually as well as physically indivisible.

Excursus: Against 'Mathematically Indivisible'

It may be appropriate here to say a few words about Furley's proposal that Democritus' atoms are conceptually (or,

⁵³See Joachim, loc. cit.

mathematically) indivisible as well as physically indivisible.⁵⁴ Furley's arguments are basically three: 1) only a mathematically indivisible atom would block Zeno's argument; 2) Aristotle admonishes the atomists for coming into conflict with mathematical sciences (Caelo 3.4, 303a20-24), and this can only refer to their positing mathematically indivisible magnitudes; and 3) Simplicius says that the atom of Democritus has no parts and thus must be conceptually indivisible.

⁵⁴Op. cit., pp. 85-101. Guthrie, History, II, 503-507, had independently come to the same conclusion. Furley's account is the most complete and so will be used here.

Michael C. Stokes, One and Many in Presocratic Philosophy (Cambridge: Harvard University Press, 1971), basically accepts Furley's analysis, although he does find inadequate Furley's answer to the question why the atomists emphasized so heavily the hardness of the atom (p. 232).

It seems evident that there may be some confusion in regard to the terminology used; and this may be generating some of the difficulty. Thus I shall specify the following usages: 1) 'conceptually divisible'--in the mathematical sense, one can conceptually divide any magnitude; 2) 'theoretically divisible'--that which has distinct parts into which it can be divided (as a chair is divisible into legs, seat, and back); and 3) 'physically divisible'--that which can in fact be physically divided (water, for example--if we neglect molecules and such--can be so divided, although it does not appear to have proper parts into which it can be divided).

It is, I contend, in senses '2' and '3' that atoms are indivisible, hence the emphasis both on their hardness and on their lack of parts.

Qua atom, the atom is not 'divisible' into further parts, for the atomic body is defined as the lowest physical part. It seems to be indivisible qua atom rather than qua magnitude.

In Metaphysics 5.6, 1016b3-6 Aristotle speaks of things which do not admit of division in thought ($\delta\alpha\alpha\ \mu\eta\ \epsilon\chi\epsilon\iota\ \delta\iota\text{-}\alpha\iota\sigma\epsilon\sigma\iota\nu$); thus man qua man does not admit of division, nor does magnitude qua magnitude (i.e., what is a single magnitude; if that were divided, it would no longer be a single magnitude). This is particularly true of primary substances ($\kappa\alpha\iota\ \tau\omicron\upsilon\tau\omicron\nu\ \delta\alpha\alpha\ \omicron\beta\omicron\upsilon\iota\alpha$). And Aristotle says that Democritus' atoms are identifiable as substances (Meta. 7.13, 1039a11).

As to Furley's first argument, that only a mathematically indivisible atom would block Zeno's argument, one must admit that it has the merit of simplicity. But there are factors which weigh against such an answer. Some of these factors have already been mentioned: there is the fact that Democritus is supposed in this respect to have been swayed by a study of nature rather than by dialectic, and the fact that the atoms have specific varieties of shapes and come in different sizes; there is a strong and conscious emphasis on physical division, not only throughout the passage as a whole, but particularly noticeable at 316b29-34, where the argument is more evidently Democritus' own (where it also seems implied that there are points on objects at which they cannot be divided).

Let us consider first the only statement in the passage which really seems to say that there are mathematically indivisible magnitudes; this is to be found at 316b15-16: ἀνδύκην εἶναι σώματα ἀδιαίρετα καὶ μεγέθη. The problem here is not so much with σώματα ἀδιαίρετα, for this obviously means bodies which are physically indivisible, such that one cannot in fact divide them. But what meaning are we to give to ἀδιαίρετα μεγέθη? Its most apparent meaning is 'indivisible magnitudes'; and here is where the difficulty lies.⁵⁵ Magnitudes are prop-

⁵⁵Sinnige, *op. cit.*, p. 146, claims that this is certainly not Democritus' view, but Aristotle's erroneous opinion of what Zeno concluded from his own argument.

But, let us assume, as we have thus far in this paper, that it is basically Democritus' response.

erties of bodies; physical division applies to bodies; so in what sense are we to take ἀδιάρπeta as applied to magnitudes? Are the minute physical bodies physically indivisible because there are mathematically indivisible magnitudes? Or are there some magnitudes which remain undivided because the physical bodies of which they are properties cannot be 'theoretically' or 'physically' divided? The latter seems to be the case for Democritus; he was more influenced by nature than by dialectic.

But, even so, let us assume for the moment that ἀδιάρπeta μεγέθη is still ambiguous; yet, when it becomes more evident in the passage that the argument is Democritus' own, the term used there is less ambiguous: ἄτομα . . . μεγέθη (316b32), 'uncut magnitudes'.

The question may then be raised as to whether Democritus' response was really intended to block the argument of Zeno after all. Aristotle nowhere says that it was. We need to return to a consideration of Physics 1.3, 187a1-3. All that Aristotle says there is that the atomists made some concessions to the argument from 'dichotomy' when they proposed 'uncut magnitudes' (ἐνέδοσαν . . . τῷ δὲ ἐκ τῆς διχοτομίας, ἄτομα ποιήσαντες μεγέθη).

But Physics 1.3, 187a1-3 also mentions a second argument to which the atomists 'made some concessions'. It may be helpful to consider briefly that second argument and the response of the atomists; there may be some similarity between the ways

in which the two responses of the atomists were made. The second Eleatic argument is roughly: if 'what is' has one meaning, then 'what is not' (the void) does not exist, and all that is is one; there is no multiplicity or motion.⁵⁶ What then is the atomists' response? They argue (as was evident also in the argument for atoms) from empirical evidence to the impossibility of the conclusion: there obviously is motion; and, if motion, then the void exists. They allow the premise, but avoid the evidently impossible conclusion by adding another sense of 'what is', though still retaining the absolute sense of 'is'--the void is simply and absolutely 'what is not'. They concede that 'what is' has one meaning, but feel compelled by empirical evidence to admit that 'what is not' also 'is'. This does not block the argument, it hedges on it by claiming two absolute senses of 'is'.

Something similar appears to happen with the response to the argument from 'dichotomy': if an object is divisible everywhere, the object is reduced to nothing. As above, empirical evidence will not allow the atomists to deny the reality of the physical object. Again, they apparently allow the premise, but argue for two senses of 'divisible': 1) there is a sense in which things are divisible everywhere, and in that sense it applies to the phenomenal object, and if that is divisible everywhere, "then the whole thing is nothing but an

⁵⁶I have added the consideration of motion here from On Generation and Corruption 1.8, 325a27, which seems to refer to a similar argument.

appearance;"⁵⁷ 2) there is also a separate and distinct sense of 'divisible' which applies to the physical object, and in this sense 'divisible everywhere' does not apply. This likewise does not block the argument of Zeno, but only hedges on it by claiming two senses of 'divisible'.

So, not only is it equally possible that Democritus' response was not intended to block Zeno's argument, but in the light of the distinction which Democritus obviously made between the physical object and the phenomenal object it is also more likely that he did not intend to block it.

Furley's second argument, from the conflict with mathematical sciences, is equally doubtful. On the assumption that atoms were only physically indivisible, mathematical science would have no real, practical application; their only application would be to phenomenal objects--which are not in fact real. This would seem to be as much a fight against mathematical science as the conceptually indivisible atom; indeed, the passage quoted above (Caelo 3.4, 303a20-24) mentions the rejection of phenomena almost in the same breath with the conflict with mathematical science. Democritus' physically indivisible atom thus robbed mathematics of its real significance; and it is Aristotle's continuing contention, especially in On Generation and Corruption 1.2, that mathematics does indeed apply to reality in a practical way. So, not only is Furley's

⁵⁷Gen. et Corr. 1.2, 316a29: καὶ τὸ πᾶν ὃν οὐδὲν ἄλλ' ἢ φαίνόμενον. Sinnige, op. cit., p. 145, rightly marks this as applicable to Democritus' teaching on sensation.

contention here not necessary (it is not the only feasible alternative), but neither is it the more likely one.

Furthermore, Furley cites Democritus' 'Cone problem', as mentioned in Plutarch, to support his claim.⁵⁸ But this too might simply show that mathematical division applied only to phenomena, and not to any real objects; it says nothing at all to substantiate Furley's claim.

Furley's third argument is equally indeterminate. Simplicius' claim that Democritus' atoms are partless is countered by another claim, again in Simplicius, that they have parts.⁵⁹ Furley recognizes this, but prefers to believe that they are partless and for that reason mathematically or conceptually indivisible. But even this does not follow; that they have no parts likely implies for Democritus that there are no proper parts into which the atom can be divided; they were not to be like the 'elements' of Anaxagoras, which always could be further divided into proper parts (Zeno's argument may well have convinced Democritus that Anaxagoras was wrong in this re-

⁵⁸Op. cit., p. 100. The problem is cited in Diels-Kranz at 68B155. If a cone is divided parallel to its base, the circle at the bottom of the top section will be either equal or unequal to the top of the bottom section; if equal, the cone becomes a cylinder; if unequal, the side of the cone is not a continuous straight line.

⁵⁹Simplicii in Aristotelis Physicorum Libros Quattuor Priores Commentaria, vol. IX, and Simplicii in Aristotelis Physicorum Libros Quattuor Posteriores Commentaria, vol. X in Commentaria in Aristotelem Graeca, both volumes ed. by Hermann Diels (Berlin: George Reimer, 1882-1895). Simplicius says that the atoms have no parts at vol. X, p. 925, lines 13ff., and that they do have parts at vol. IX, p. 82, line 1.

spect). That Democritus' atoms had no parts most likely meant for him precisely that they were 'theoretically' and 'physically' indivisible. Thus there is no real contradiction to the other statement by Simplicius that atoms do have parts, for Aristotle points out that, since they have magnitude, they do indeed have parts of a sort and, as such, they are for an Aristotelian that which can at least theoretically be divided. Again Furley's argument is shown to be ineffective; he has not supported his contention that they were mathematically indivisible. Thus, in this respect too Democritus' atoms were more likely 'physically' indivisible but 'conceptually' further divisible.

More on Democritus' Atom as the Unit

Thus driven by Zeno's argument on divisibility and by empirical considerations--contraries in the same phenomenal object--to deny that the phenomenal object is real and to hold that the physical object is composed of physically indivisible bodies, Democritus posited his atomic bodies as that which really exists, as τὸ ὄν. Although his response is in terms of Eleatic 'being' (and 'not-being'), and although Democritus still uses 'is' in an absolute sense--like the Eleatics in this respect--yet the meaning of 'what is' for Democritus is different enough that he may also be considered apart from the Eleatic tradition, in that his 'being' has body, is in motion, has bulk, and is in fact perceptible (although not actually seen or, perhaps, felt in isolation). Democritus' being is in fact

the real matter which constitutes physical objects and accounts for phenomenal objects.

It is in this respect that Aristotle at Metaphysics 4.5, 1009a27-30 rightly puts Democritus in the tradition of Anaxagoras, for, like Anaxagoras, he had attempted to account for such contraries in the phenomenal object. But Democritus accounts for them by referring them to the prime contraries, 'what is full' and 'what is empty', that is, 'what is' and 'what is not'. Precisely as such contraries these elements are present at any given section of the physical object: καὶ ὅτι οὖν ὑπάρχειν μέρος--1009a28-29.

Aristotle describes a little more fully the way in which the atoms accounted for the varieties of contraries in phenomenal objects at Physics 1.5, 188a22-26. Here again, according to Aristotle, Democritus proposed 'the full' as 'what is' (τὸ πλήρες . . . ὡς ὄν--188a22-23); and the atoms are there described as having different shapes (σχήματος γεγωνιωμένον ἀγώνιον, εὐθὺ περιφερές--188a25-26) in terms of contraries. These then are some⁶⁰ of the prime atomic and physical contraries which help account for contraries in phenomenal objects.

Aristotle once more says that Democritus specifies 'the full' as 'what is' at Metaphysics 1.4, 985b4-10; this time he adds the term στερεόν ('solid')--obviously a reflection of ναστόν--to describe the atom. The atom is thus to be consid-

⁶⁰Others, such as those contributed by the relative position of an atom, will be more fully discussed in the third chapter in connection with the structure of physical objects.

ered as more than merely being 'full' or 'full being' in the abstract sense; it is an absolutely solid physical substance; it is full (and undifferentiated) matter. Such atoms (along with the void) are the physical matter which constitutes physical objects: αἴτια δὲ τῶν ὄντων ταῦτα ὡς ὕλην --985b9-10.

The varying size of these atoms also contributes to an explanation of phenomenal characteristics of physical objects. Aristotle cites the fact that the atomists made the distinctions between water, air, and other objects ones due to size (ἀέρα δὲ καὶ ὕδωρ καὶ τᾶλλα μεγέθει καὶ μικρότητι διεῖλον--Caelo 3.4, 303a14-15), with the distinction being obviously the size of the atoms constituting these objects. Furthermore, the generation of one such object from another is due to the separating out of the largest atoms: τὰ μέγιστα σώματα ἐκκρινόμενα, φασὶ δ' οὕτω γίνεσθαι ὕδωρ καὶ ἀέρα καὶ γῆν ἐξ ἀλλήλων--Caelo 3.4, 303a27-29. This evidently means that water, for example, is composed of a variety of atomic sizes, with more larger atoms than, for instance, air. This accounting for differences between objects by the sizes of atoms they contain is supported by a similar account by Aristotle of Democritus' theory at On the Heavens 3.7, 305b22-26.

So every other thing that there is is composed of these atoms with their varying shapes and sizes: ἐκ σωμάτων ἀδιαίρετων τᾶλλα συγκεῖσθαι --Gen. et Corr. 1.1, 314a21-22. But because of the apparent infinite variety of phenomenal differences, they proposed an infinite number of atoms: ἅπειρα τὰ

φαινόμενα, τὰ σχήματα ἄπειρα ἐποίησαν -- Gen. et Corr. 1.2,
315b9-10.⁶¹

These atoms themselves are and forever remain the same, whether as part of a physical object or apart from it in isolation. There is no change in the atom itself, not even to account for change in the physical (or in the phenomenal) object; the atom has none of the 'secondary qualities' (e.g., color, heat, relative hardness) nor can it receive one. It is thus described by Aristotle as being ἀπαθές (Gen. et Corr. 1.8, 326a1). The only 'motion' that is possible for it is locomotion, the movement of the otherwise changeless atom through the void.⁶²

All other motions are explained by the atomists simply and solely in terms of that locomotion. The generation and corruption of a physical object for them amounts to no more than the addition and subtraction of atoms of that group that constitutes the object in question; alteration is explained simply by the shifts of those atoms already in the object.⁶³

⁶¹For their infinite number see also Physics 3.4, 203a20 and Caelo 3.4, 303a6. Leo Elders, Aristotle's Cosmology (Assen: Royal van Gorcum, 1966), p. 301, note 1, suggests that we should rather speak of an indeterminate number. But, one wonders, if the number of different shapes--as a sub-set of atoms--is also infinite, might not 'infinite' after all be quite appropriate?

⁶²See Physics 8.9, 265b24-26: καὶ γὰρ οὗτοι τὴν κατὰ τόπον κίνησιν κινεῖσθαι τὴν φύσιν λέγουσιν (ἡ γὰρ διὰ τὸ κενὸν κίνησις φορὰ ἐστὶν καὶ ὡς ἐν τόπῳ).

⁶³Gen. et Corr. 1.2, 315b8-9: διακρίσει μὲν καὶ συγκρίσει γένεσιν καὶ φθοράν, τάξει δὲ καὶ θέσει ἀλλοίωσιν.

Thus, for instance, the generation of air from water takes place by the separating out of the largest atoms (Caelo 3.4, 303a27-29). The coloration of an object actually takes place by change in the position of the atoms in that object (Gen. et Corr. 1.2, 316a1-2); and the change from a fluid state to a solid state in the same object similarly takes place only by such shifts (Gen. et Corr. 1.9, 327a16-19). Thus, in the midst of all phenomenal change, the atoms themselves remain absolutely unchanged.

Indeed, it is because these atomic shapes retain the function of their various shapes that the characteristics which we ascribe to the physical object are explained. Fire is extremely mobile and penetrates objects quite readily and so breaks them up precisely because the spherical shapes which constitute it have and retain those characteristics even when they are parts of the physical object which we call fire; and soul is extremely sensitive to motion and thus is also able to set other things into motion for the same reason (Anima 1.2, 404a2, 6-8). Objects appear to us black or white, they appear to have particular flavors because the atomic shapes in such objects are of a certain variety (Sens. 4, 442b11-14). Thus it is an essential part of Democritus' system of the explanation of the characteristics of phenomenal objects that the atoms retain their shapes and the specific functions of those shapes, that they remain impassible, that they remain always the same.

Thus, the atoms themselves can have no potency. Charac-

terized by being simple and unqualified matter, by having a specific shape and size and, perhaps, weight,⁶⁴ they simply are, in an Eleatic absolute sense of 'is'; they are one of those things which always is (τὴ αἰεὶ . . . ἔστιν--Physics 8.1, 252a33), and to which as a sufficient principle Democritus refers as the causes that explain nature.⁶⁵ These physical atoms are therefore in eternal actuality.

Furthermore, since it is and remains such a physical unity and theoretically indivisible, Democritus' atom is identifiable as the real substance. This, Aristotle claims at Metaphysics 7.13, 1039a9-10, is what Democritus taught; the passage in which this citation is found (1039a7-11) may be translated as follows:⁶⁶

"And so, if the substance is a single thing, it will not consist of substances existing in it, and in this way Democritus is right, for he says that it is impossible for a unity to be generated out of two things [atoms] or

⁶⁴The question whether the atoms have weight will be discussed in chapter two.

⁶⁵Physics 8.1, 252a32-35: νομίζειν ἀρχὴν εἶναι ταύτην ἱκανὴν, εἴ τι αἰεὶ . . . ἔστιν . . . ἐφ' ὃ Δημόκριτος ἀνάγει τὰς περὶ φύσεως αἰτίας.

⁶⁶1039a9-10 reads: ἀδύνατον γὰρ εἶναι φησιν ἐκ δύο ἐν ἡ ἕξ ἑνὸς δύο γενέσθαι. The point that Aristotle makes here in citing Democritus is that two actual atoms as substances can not constitute a new unity, nor can a single atom contain two (or more) actual 'sub-atoms'. See Ross, Metaphysics, II, 209, 211.

Cherniss, op. cit., p. 341, note 18, says that Aristotle is reading into the physical doctrine of atomism his own metaphysical principles. But, if Democritus had not held precisely the position that Aristotle here attributes to him, had he admitted either that atoms may merge to form a unified physical object, or that they may actually be divided into 'sub-atoms' the physical object would be reduced to nothings, an illusion.

for two things to arise from what is one [an atom], for he makes his atomic magnitudes substances."

Aristotle here makes at least one point quite clear about Democritus' atoms, that is, that they intentionally and by definition do not consist of further atoms as actual parts. This may very well mean that Democritus' atom was indivisible in somewhat the same sense that a substance for Aristotle was indivisible, that there are no actual substances as parts in it into which it can be divided, that the atom was thus not indivisible because its magnitude was mathematically indivisible, but simply because it had no proper parts into which it could be divided.

But the point about ἀδύνατον . . . ἐκ δύο ἐν . . . γενέσθαι (1039a9-10) is not quite as clear. Ross evidently takes this as meaning "a single atom cannot be produced out of two atoms."⁶⁷ But that does not seem to be quite the point that Democritus was making with this statement; and that Aristotle evidently did not take it that way becomes clearer from the two other instances in which Aristotle quotes this teaching of Democritus. The first of these is from On Generation and Corruption 1.8, 325a34-36:⁶⁸

" . . . and when they [the atoms] are set together and involved with one another, they produce physical objects. And a multitude would not arise from what is truly one, nor would what is one arise from those things which are

⁶⁷Ross, Metaphysics, II, 209.

⁶⁸καὶ συντιθέμενα δὲ καὶ περιπλεκόμενα γεννᾶν. ἐκ δὲ τοῦ κατ'ἀλήθειαν ἑνὸς οὐκ ἂν γενέσθαι πλῆθος οὐδ' ἐκ τῶν ἀληθῶς πολλῶν ἑν, ἀλλ' εἶναι τοῦτ' ἀδύνατον.

truly many, but it is impossible that they would."

The second passage is at On the Heavens 3.4, 303a6-8:⁶⁹

"... and [they claim] that many things are not generated out of what is one [the atom] nor is one thing generated out of what is many [the atoms], but all things are produced by the involvement and scattering around of these atoms."

In both these passages the generation or structure of physical objects is connected with Democritus' claim, and it is most likely that to which this second part of Democritus' claim is to be connected.⁷⁰ The claim then is that when atoms congregate to form a physical object they do not in fact form a unity. Here then is likely an explicit denial on Democritus' part that the physical object is a real unity, a claim, therefore, that the phenomenal unity of the object is nothing but an illusion.

Thus now, taking both parts of Democritus' claim together, inasmuch as the atoms cannot be further divided in themselves, and inasmuch as these atoms, when they form a physical object, do not in fact form a real unity, these atoms are the only true and physical unit that there is.

⁶⁹καὶ οὐτ' ἐξ ἑνὸς πολλὰ γίνεσθαι οὔτε ἐκ πολλῶν ἓν, ἄλλ' τῇ τούτων συμπλοκῇ καὶ περιπαλάξει πάντα γεννᾶσθαι. I follow Elders, op. cit., p. 300, and Kirk and Raven, op. cit., p. 418, in translating περιπαλάξει as 'by scattering around'.

⁷⁰Joachim, op. cit., p. 163 rightly identifies the τὸ κατ' ἀλήθειαν ἓν with the individual atom and the τὰ ἀληθῶς πολλὰ with an aggregate of atoms, which, though forming a perceptible body, never constitute a real unit. And, if this is the meaning of Democritus' claim here in On Generation and Corruption 1.8, 325a34-36, then this is evidently the way in which this same claim of Democritus is to be taken in the passage at Metaphysics 7.13.

Aristotle's Criticism: Against the Denial of the Unity of the Physical Object

In the world of nature for Aristotle it is the individual physical object, the primary substance, which is 'one' thing in the strictest sense of the term; upon its unity depends not only accidental unity (Meta. 5.6, 1015b16-36), but also unity in species, in genus, and by analogy (1016b31-1017a3). It is this primary substance which is 'one' by continuity: τῶν δὲ καθ' ἑαυτὰ ἐν λεγομένων τὰ μὲν λέγεται τῷ συνεχῇ εἶναι (1015b36-1016a1).⁷¹ And it is this which is 'one' in the primary sense, for its οὐσία (substance, informed matter) is one; and it is 'one' because it is continuous, because its form is one and its definition is one: τὰ δὲ πρῶτως λεγόμενα ἐν ᾧ ἡ οὐσία μία, μία δὲ ἡ συνεχής ἡ εἶδος ἡ λόγος (1016b8-9). And this is the first major point on which he criticizes the teaching of Democritus on the atom as the real physical object and unity.

But it is not only the teaching that there are atomic shapes in reality that negates the real unity of the physical object, but also the doctrine of the void, which in the physical object separates those atoms which constitute that object. And there are in Democritus' teaching a number of phenomena which are explained more from the point of view of the void--such as, expansion, contraction, growth, and motion. And,

⁷¹Two things are continuous when they have a single boundary in common (Physics 5.3, 227a21-23). If two parts are to become a unity in the strict sense, it is necessary that they have this boundary in common.

although these explanations too involve an unnecessary and unreasonable denial of the unity of the individual physical object, they will be considered in chapter two of this paper in connection with the doctrine of the void. The discussion here in this chapter will be limited to those of Aristotle's criticisms which trace this denial of the unity of the physical object more immediately and directly to the teaching that there are atomic shapes.

Specifically, Aristotle's criticisms of atomic shapes in this respect is that such atoms not only deny obvious and evident unities,⁷² but also do not, and cannot in principle, account at all for all the facts.

First of all, if one argues from empirical evidence--and the atomists evidently did--Aristotle claims in On the Heavens 3.8, 306b3-5, 9-15, that a doctrine of differentiation of simple bodies by basic shapes is unreasonable. This criticism seems to be directed not only against Plato's views, but also against any attempt in general to reduce the simple bodies to shapes: ὅλος δὲ τὸ πειρᾶσθαι τὰ ἀπλᾶ σώματα σχηματίζειν ἄλογόν ἐστι--306b3-4. Such attempts are cited as being unreasonable in the first place because, in that case, the simple bodies cannot fill up a whole or constitute a material continuity (306b4-5). But, more importantly, in the second place, we have empirical evidence (φαίνεται --306b9) that simple bodies do

⁷²That such a denial is, furthermore, unnecessary and thus unwarranted will be shown in the latter part of this chapter.

adjust their form to suit their container, especially water and air. If the basic shape of the element remains, it will certainly not fill its container as a whole:⁷³ οὐ γὰρ ἂν ἤπτετο πανταχῇ τοῦ περιέχοντος τὸ ὅλον --306b12-13; and that would be contrary to empirical evidence.⁷⁴ Thus, to account for simple bodies in terms of specific shapes is to deny the wholeness and continuity of such a body and to deny empirical evidence. Aristotle reasonably chose empirical evidence: ὥστε φανερόν ὅτι οὐκ ἔστιν ὁρισμένα τὰ σχήματα αὐτῶν --306b14-15.

A second basic unity which Democritus by his atomic theory denies is the real unity of the individual animate creature. This is a unity of a higher order, for it is one supplied by nature itself and is not artificially imposed on the creature.⁷⁵ It was Democritus' view that soul consists of spherical shapes;⁷⁶ this, by itself, strongly implies that soul

⁷³Elders, op. cit., p. 323, remarks on ὅλον: "It signifies a coherent and substantial unity (Aristotle's outlook is from the outset different from that of the atomists)."

It is precisely such a ὅλον which is at issue with Democritus, and thus the argument here applies to Democritus' position as well.

⁷⁴Ibid., p. 322, where Elders rightly remarks: "Aristotle makes here a very important criticism on a point overlooked by Plato, viz. of how space, not informed by figures, can be real."

I do not doubt that this criticism is directed primarily against Plato; but it involves the citation of empirical evidence against any view that holds a reduction of simple bodies to specific shapes that is significant.

⁷⁵Metaphysics 5.6, 1016a4: μᾶλλον ἐν τὰ φύσει συνεχῇ ἢ τέχνῃ.

⁷⁶See, for example, Anima 1.2, 404a2: ἀτόμων τὰ σφαιροειδῇ πῦρ καὶ ψυχὴν λέγει.

is not a continuum and cannot itself be a unified thing. Furthermore, if, as Democritus seems to hold, this soul is scattered throughout the percipient body (Anima 1.5, 409b2), and soul is taken to be some sort of body itself, then there will actually be two bodies in the same place; the animate creature itself will really consist of two bodies (409b3-4). It will not be a unity at all.

Furthermore, Aristotle objects specifically to Democritus' theory of alteration on the same grounds at On Generation and Corruption 1.9, 327a15-22. The example cited there is the change of the same body (τὸ αὐτὸ σῶμα--327a16) from a liquid to a solid;⁷⁷ this, Democritus claims, occurs by the shifting of positions of the constituent atoms: τροπῇ καὶ διαθίγῃ καθάπερ λέγει Δημόκριτος--327a18-19. Here Aristotle appeals to empirical evidence (ὁρῶμεν--327a16) for the continuity of the physical object before and during and after the change:

συνεχὲς ὃν ὅτε μὲν ὑγρὸν ὅτε δὲ πεπηγός --327a17.⁷⁸ The object was and remained a continuous whole throughout the process of change; empirical evidence again contradicts the position of

⁷⁷I take the most reasonable referents to be the κρύσταλλος at 1.8, 325a22 and the ὕδωρ at 326a34, although it is not essential to the argument that they be so identified.

⁷⁸Also 327a22: ἅπαν ὑγρὸν, ὅτε δὲ σκληρὸν καὶ πεπηγός ἐστιν.

Cherniss, op. cit., p. 105, contends that here Aristotle seems quite naive in that Aristotle should expect to see the atoms moving. But Cherniss' emphasis is wrong; Aristotle says that we have empirical evidence for the continuity of the object during alteration, not that he fails to see the atoms moving. This makes a great deal of difference, for thus the burden of proof is on Democritus, not on Aristotle.

Democritus.

The same thing is true with regard to Democritus' theory of generation and corruption, for he taught that generation and corruption occur by the addition and subtraction of atoms from the mass of atoms which constitute the physical object (Gen. et Corr. 1.2, 315b16-17); this means that for Democritus a new object is generated whenever a single atom is added to the original group. This too is contrary to empirical evidence, for, as Aristotle points out at On Generation and Corruption 1.4, 319b14-17, generation and corruption occur precisely when the physical object changes as a whole,⁷⁹ and nothing perceptible persists as an identical substratum--as when seed changes to blood, or water to air. When a physical object changes, it is obvious that the kind of change which involves generation or corruption is a change of the object as a whole, and not just some (perhaps minute) part of it.

Furthermore, not only does Democritus' theory negate phenomena, but also, Aristotle points out, precisely in connection with the mutual generation of the simple bodies the theory of atomic shapes cannot even in principle account for the facts of phenomena, although they were supposed to do exactly that.

Aristotle's criticism of this inconsistency in atomism is

⁷⁹See Joachim, op. cit., p. 108, and Verdenius and Waszink, op. cit., p. 17, on the meaning of ὅλον here.

The passage is as follows: ὅταν δ' ὅλον μεταβάλλῃ μὴ υπομένοντος αἰσθητοῦ τινος ὡς υποκειμένου τοῦ αὐτοῦ ἀλλ' οἶον ἐκ τῆς γονῆς αἷμα πάσης ἢ ἐξ ὕδατος ἀῆρ ἢ ἐξ ἀέρος παντὸς ὕδωρ, γένεσις ἤδη τὸ τοιοῦτον, τοῦ δὲ φθορά.

to be found at On the Heavens 3.4, 303a24-29. The atomists are there said to have differentiated the 'traditional elements'--earth, air, and water--by the size of the atoms which constitute those elements: μέγεθαι καὶ μικρότητι διαφέρειν ἄερα καὶ γῆν καὶ ὕδωρ--303a25-26. This is not to say that water, for example, is composed of atoms all of one size, but rather that one particular size of atom predominates in the group, which is composed of all sizes of atoms. One of these 'elements', they further claim, is generated from another when the largest atoms are separated out; for example, 'earth' becomes 'water' when the largest atoms are separated out from the 'earth'; and this is the way in which the mutual generation of 'elements' takes place (303a27-29).

But this, Aristotle rightly points out, generates an internal contradiction: ἐναντία λέγειν αὐτοὺς αὐτοῖς ἀνάγκη -- 303a24-25.⁸⁰ The contradiction obviously lies in the fact that when the largest atoms separate out from the earth, and water is thus formed, there are evidently no such 'largest atoms' in the water which results from this process so that 'earth' can again be generated out of it. If these 'largest atoms' are an essential constituent of 'earth', and if 'earth' can in turn be generated from 'water', then the water must contain them; but

⁸⁰Elders, op. cit., fails to point out where the contradiction lies. Cherniss, op. cit., p. 6, assumes that it lies with contradicting the fact that the process of change is eternal, and that on atomist grounds it must cease; but this is not an internal contradiction in the atomists' system.

Cherniss concludes from this fact that the refutation rests on a false account of the atomists' theory.

they will be lacking to the 'water' because they have been separated out. Here is where the contradiction lies, and this is exactly where Aristotle says that it lies: ὑπολείψει γὰρ ἀεὶ τὰ μέγιστα σώματα ἐκκρινόμενα --303a27-28.⁸¹ Thus the atomists, although they claim to account for the mutual generation of the elements, in fact cannot do so without self-contradiction.

Thus, in summary, although Democritus had begun with phenomena and indeed tried to preserve them with accounts of reality which were in harmony with them (λόγους οἵτινες πρὸς τὴν αἴσθησιν ὁμολογούμενα λέγοντες --Gen. et Corr. 1.8, 325a23-24), he ended by negating many of the opinions and facts of observation: πολλὰ τῶν ἐνδόξων καὶ τῶν φαινομένων κατὰ τὴν αἴσθησιν ἀναιρεῖν--Caelo 3.4, 303a22-23. Not only did he deny the real and empirical unity of the physical object, but also in some cases his theory did not even fit the admitted facts as it was supposed to do.

But the denial of phenomena and empirical evidence in itself is not so serious a charge, if that denial is justified in some respect. But Democritus' justification of that denial was made on two grounds: 1) the problem of 'division everywhere'

⁸¹Both Cherniss, loc. cit., and Simplicius, On de Caelo, 612.26-613.4, see the point of the criticism as being that of the 'ceasing of generation', evidently in anticipation of the criticism offered by Aristotle at On the Heavens 3.7, 305b20-26. But Aristotle's criticisms differ in these two places; at On the Heavens 3.4 the point is made that ὑπολείψει . . . τὰ μέγιστα σώματα, while at On the Heavens 3.7 it is ὑπολείπειν τὴν ἐξ ἀλλήλων γένεσιν.

seemed to Democritus to indicate that the continuous appearance of phenomenal objects was an illusion and that this 'division everywhere' simply did not apply to the real physical object at all; and 2) since empirical evidence must be basically reliable, the problem of contraries in the same object indicated that the physical object must be distinguished from the phenomenal object.

But Aristotle does in fact show that Democritus' assumption was not really justified, that Democritus' conclusion about atomic magnitudes was not a warranted one, because it was not necessary. He does this by showing that Democritus' solution to the problem of 'divisible everywhere' was based on a mistake in logic and by showing that the problem of contraries in the same object can reasonably be settled without resorting to an extreme and unwarranted rejection of empirical evidence. This demonstration by Aristotle that Democritus' rejection of phenomena on two counts was not justified will be discussed in the next two sections of this paper, the first dealing with the problem of 'division everywhere', and the next with contraries in the same object.

Aristotle's Criticism: 'Division Everywhere' Holds

Democritus had based his rejection of phenomena partly on the problem raised by Zeno involving 'divisible everywhere'. Aristotle, in reply, points out that Democritus' conclusion is not warranted by his premises, that the positing of indivis-

ible atoms rests on a mistake in logic, and that thus Democritus' rejection of phenomena is not justified in this respect.

And the passage in which Aristotle's reply to Democritus' position is most direct and explicit is at On Generation and Corruption 1.2, 316b19-317a17. In the first portion of this passage (316b19-27), as we have already pointed out, Aristotle shows that there are two distinct meanings of $\pi\acute{\alpha}\nu\tau\eta$ ('everywhere') in 'divisible everywhere', the one distributive and the other collective--'at any of all the points' and 'at all the points at once'. But it is only the second of these meanings which generates the difficulty, the meaning 'divisible everywhere at once', for this is the only one which actually reduces the body to 'nothings'.

So, having rightly established the two senses of 'everywhere', Aristotle is now ready to show that Democritus' conclusion (that there must be atomic magnitudes) does not follow from the premises he accepts, that it involves an unnoticed mistake in logic ($\lambda\alpha\nu\theta\acute{\alpha}\nu\epsilon\iota\ \pi\alpha\rho\alpha\lambda\omicron\gamma\iota\zeta\acute{o}\mu\epsilon\nu\omicron\varsigma$ --317a1-2); and it is precisely this mistake that he points out in 317a2-12:⁸²

⁸² ἐπεὶ γὰρ οὐκ ἔστι στιγμή στιγμής ἐχομένη, τὸ πάντῃ εἶναι διαιρετὸν ἔστι μὲν ὡς ὑπάρχει τοῖς μεγέθεσιν, ἔστι δ' ὡς οὐ. δοκεῖ δ', ὅταν τοῦτο τεθῇ, καὶ ὀπηρεῖν καὶ πάντῃ στιγμήν εἶναι, ὥστ' ἀναγκαῖον εἶναι διαιρεθῆναι τὸ μέγεθος εἰς μηδέν--πάντῃ γὰρ εἶναι στιγμήν, ὥστε ἢ ἐξ ἀφῶν ἢ ἐκ στιγμῶν εἶναι. τὸ δ' ἔστιν ὡς ὑπάρχει πάντῃ, ὅτι μία ὀπηρεῖν ἔστι καὶ πᾶσαι ὡς ἐκάστη. πλείους δὲ μιᾶς οὐκ εἰσὶν (ἐφεξῆς γὰρ οὐκ εἰσὶν), ὥστ' οὐ πάντῃ εἰ γὰρ κατὰ μέσον διαιρετὸν, καὶ κατ' ἐχομένην στιγμήν ἔσται διαιρετὸν· οὐ γὰρ ἔστιν ἐχόμενον σημεῖον σημείου ἢ στιγμής.

Verdenius and Waszink, *op. cit.*, pp. 14-15, point out that T. W. Allen's conjecture at 317a11 'διαιρετὸν <οὐκ ἔστι δε>' οὐ γὰρ ' was not necessary and may be omitted without changing the meaning of the passage.

"Since one point is not next to another point, 'divisible everywhere' is in one sense a property of magnitudes, and in another sense it is not a property of magnitudes.

"Whenever it is proposed [that 'divisible everywhere' is a property of magnitudes], it is thought that there is a point both anywhere and everywhere [on that magnitude at which such division is to occur], and thus that 'divisible everywhere' necessitates the division of the magnitude into nothing, for there is a point everywhere [collectively] on it. So, on that assumption, the magnitude must be composed of either contacts or points.

"But there is another sense of 'everywhere', namely, that there is one point at any given place on the magnitude, and so all the points of 'everywhere' are taken distributively, one at a time.

"But there is no more than one [point at a time which one can take for such division], because the points are in fact not next to one another; and so [in this sense again, since one can never in fact arrive at a point next to a point and thus take them collectively,] the magnitude is not 'divisible everywhere'; for, if the magnitude is divisible [everywhere] collectively, and] if it is divisible at its middle, it will also be divisible at the point right next to that; but it is not, for moment is not next to moment, nor is one point next to another."

Thus Aristotle rightly points out that the mistake in logic⁸³ rests on the ambiguity of the term παντα ('everywhere') as it was used by Democritus in formulating his conclusion; it has both a distributive and a collective sense. So, to put the atomists' argument into the form of a syllogism: A) 'what is "divisible everywhere" (collective sense) can be resolved into nothing'; B) 'any body is "divisible everywhere" (distributive sense)'; therefore C) 'any body can be resolved into nothing'.

⁸³Furley, *op. cit.*, p. 92, translates the note οὐ παντα at 317a9 as "and so they are not everywhere." His "they" evidently refers to 'points'. But Aristotle would hardly admit that, for it would mean that the magnitude is not in fact divisible everywhere in either the collective or the distributive sense and would drive him to admit that Democritus was right after all and did not commit an error in logic. If this is what Furley means, he seems to be wrong.

The middle term, 'divisible everywhere', was used equivocally.⁸⁴ But, since Democritus' rejection of a real 'divisible everywhere' for physical objects was grounded on the validity of this argument which Aristotle has now shown to be fallacious, and since Democritus' relegation of the phenomenal object to 'illusion' was at least partially based on the validity of this argument as well, Aristotle has quite rightly shown that Democritus had no adequate reason in this respect either for the positing of atoms or for his doubts about phenomena.

Indeed, Aristotle goes on to say (317a12-17), there is a division of a body (and a reconstruction of that body out of its parts), but it is a division which neither results in indivisible bodies nor exhausts all the points of the body, but one which simply and constantly results in smaller and smaller magnitudes: ἀλλ' εἰς μικρὰ καὶ ἐλάττω ἐστὶ --317a16. There is no adequate reason for stopping the division at some specific magnitude. But the reason, according to Aristotle, that such division may continue without exhausting all the points is to be found in the very nature of 'infinite', which he takes up elsewhere.

Now it is in the third book of the Physics where Aris-

⁸⁴So Joachim, op. cit., p. 84. Sinnige, op. cit., p. 148, sees the 'inconsistency' as lying in the incompleteness of the division, for the atom--like the ἔκπρισμα of 316b1--must be still further divisible, if it has magnitude, and if it is to be reduced to something mathematically indivisible; this is certainly a valid criticism of Democritus' position, but it is not the one which Aristotle makes here.

totle takes up the nature of the infinite, more specifically, in chapters six and seven. His definition of the infinite is 'such a quantity that one can always take as part of it something outside of what has already been taken'.⁸⁵ This means that what is infinite is by its very nature something which is never really attained, because it is never stationary, it always stays outside of our grasp; it is simply its nature to be always in process: οὐδὲ μένει ἡ ἀπειρία ἀλλὰ γίνεται --3.7, 207b14. This means that by its very definition it is only potential, never actual: λείπεται οὖν δυνάμει εἶναι τὸ ἄπειρον. οὐ δεῖ δὲ τὸ δυνάμει ὄν λαμβάνειν . . . οὕτω καὶ ἄπειρον ὃ ἔσται ἐνεργείᾳ--3.6, 206a18-21.⁸⁶

The most obvious application of such a notion of the infinite is to numbers--what Aristotle would call 'infinite by addition' (προσθέσει--3.6, 206a15). Numbers have a lower limit, the unit, but have no upper limit, because one can always exceed in thought any number, no matter how high (3.7, 207b1-3, 10).

In this respect the infinite by bisection resembles that by addition, for in any given magnitude every assigned magnitude is surpassed in the direction of smallness (3.7, 207b3-4). This means that there is by definition always a smaller magni-

⁸⁵Physics 3.6, 207a7-8: ἄπειρον μὲν οὖν ἐστὶν οὗ κατὰ ποσὸν λαμβάνουσιν αἰεὶ τι λαβεῖν ἔστιν ἔξω.

⁸⁶There is, however, Aristotle admits, a sense in which we can speak of the 'actuality' of an infinite, but only in the sense that a finite extension actually contains an infinite number of progressively smaller parts--206b12-15.

tude than any assigned small magnitude. And the bisections of any magnitude are infinite; so, as the infinitely high number is always only potential, never actual, likewise the infinitely small magnitude will be always potential, never actual; it can always be exceeded in the direction of smallness.⁸⁷ Hence such division can never by definition be exhausted.

Thus also Democritus was not justified in stopping the actual division arbitrarily at a specific magnitude; his fears about the actual exhaustion of the 'division everywhere' were by the very nature of the case unfounded. 'Division everywhere', while it is possible, is precisely such a potency as cannot in fact be actualized.

Furthermore, since Aristotle has now shown that Democritus has no adequate reason for stopping actual division at a specific magnitude, there is no reason why Democritus' atoms themselves should not be subject to further (infinite) divisibility. Any given Democritean atom is certainly 'continuous'; it is defined as being 'full' or 'absolutely full' (πλήρες, παμπληρές); it also has magnitude; and as such it itself is divisible infinitely: "And it is evident that everything continuous is divisible constantly into further divisible parts" (φανερὸν δὲ καὶ ὅτι πᾶν συνεχὲς διαιρετὸν εἰς ἀεὶ διαιρετὰ -- Physics 6.1, 231b15).

⁸⁷Physics 3.7, 207b10-13: ἄπειροι γὰρ αἱ διχοτομίαι τοῦ μεγέθους. ὥστε δυνάμει μὲν ἐστίν, ἐνεργείᾳ δ' οὐ. ἀλλ' ἀεὶ ὑπερβάλλει τὸ λαμβανόμενον παντός ὁρισμένου πλήθους.

This means that the atom is indeed no better off than the ἔκπρισμα described at On Generation and Corruption 1.2, 316a34-b2. This 'particle' is conceived as having resulted from the division of a body with magnitude; and so, if this 'particle' is a body of some sort, the same argument applies to it as applied to the original body; it too should be divisible in the same sense: [εἰ] οὕτως ἐκ τοῦ μεγέθους σῶμα τι ἀπέρχεται, ὁ αὐτὸς λόγος--316b1-2.

Again, Democritus had likely argued that his atoms were physically indivisible in that they had no proper parts into which they could be divided, that is, parts like those of the 'elements' of Anaxagoras. But Aristotle points out in On the Heavens 3.4, 303a29-b2 that as geometrical shapes the atoms do indeed have parts of a sort into which they could be divided; they can be divided into further and simpler geometrical shapes as their parts,⁸⁸ for instance, into a variety of pyramids: τὰ δὲ σχήματα πάντα σύγκειται ἐκ πυραμίδων, τὰ μὲν εὐθύγραμμα

⁸⁸The argument is directed primarily against Democritus' theory of an infinite variety of atomic shapes; and Aristotle shows that by dividing atoms into a finite number of simple shapes, the variety of shapes of atoms would not be infinite.

Furley, op. cit., p. 98, believes that since Aristotle applied this argument against the atomists "with hostile intent", the atomists must not have conceived of their atoms as being reducible in this way. But, even so, that does not establish Furley's conclusion of a mathematically indivisible atom.

Cherniss, op. cit., p. 7, objects to the use of this argument by Aristotle on the grounds that he is using a doctrine of Plato--that material body is constructed out of discrete and immaterial form--to refute Democritus. But the source of the argument is immaterial; its applicability is the only real issue.

ἐξ εὐθυγρόμων, ἢ δὲ σφαῖρα ἐξ ὁκτὼ μορίων--303a31-b1. Thus the atoms themselves may very well have parts, and there is no reason why they could not be divided into these parts.

Furthermore, Aristotle says at On Generation and Corruption 1.8, 326a24-29 that Democritus' physically indivisible atoms were quite small, but there were no large ones; and this, Aristotle says, is quite reasonable, because larger things are broken up (θραύεται--326a26) more easily than small things. Indeed, it may very well be this empirical consideration that the degree of breakability depends on size that contributed to Democritus' notion that the atoms' indivisibility is partially a function of their size. Again, there is a strong emphasis on physical divisibility. But, Aristotle points out in reply, such physical divisibility is relative; it is only a matter of the comparative ease or difficulty with which it can be carried out. This, it seems, is already implied in διαλύεται ῥαδίως--326a27. Democritus, he says, thus gives no adequate reason why indivisibility is a property of small things but not of large ones: τὸ δὲ ἀδιαίρετον ὅλως διὰ τί μᾶλλον ὑπάρχει τῶν μεγάλων τοῖς μικροῖς; (326a28-29).⁸⁹ Thus, again, there is in atomic theory no real reason why atoms could not in fact be

⁸⁹On Furley's hypothesis of mathematically indivisible units (Furley does not consider this passage) for Democritus Aristotle would be saying that Democritus has given no adequate reason for there not to be larger mathematically indivisible units as well as smaller ones!

But the passage is evidently directed against physically indivisible atoms; and Aristotle is right in saying that there is no adequate reason for physical indivisibility to be a property of one magnitude rather than another.

further divided.

And so, in summary, Aristotle has quite consistently and rightly shown that Democritus was not justified in positing indivisible atoms; Democritus had drawn unwarranted conclusions from the problem of 'divisible everywhere', and thus he had no adequate reason for making his atom indivisible. And this means, further, that in this respect at least Democritus' repudiation of phenomena was also unwarranted.

Excursus: On Aristotle's Minimae Partes

It may be objected that Aristotle too has limits to which actual division can in fact take place, and that thus his objections to atomism are weakened. Such a doctrine of limits in minimum size or in division is his teaching on minimae partes. And the passages in which this teaching is found follow.

Physics 1.4, 187b20-30:⁹⁰

"Clearly, then, neither flesh nor bone nor anything of that sort can proceed indefinitely far either in enlargement or in diminution.

"Again, if all such things are already present in one another, and do not come into existence, but are merely separated out after being there all along, objects getting their appellation from whatever is present in most

⁹⁰ὁ ἅλιν τοῖνυν ὅτι ἀδύνατον σάρκα ἢ ὅσοι ἢ ἄλλο τι ὀνη-
λικοῦν εἶναι τὸ μέγεθος ἢ ἐπὶ τὸ μείζον ἢ ἐπὶ τὸ ἔλαττον. ἔτι
εἰ πάντα μὲν ἐνυπάρχει τὰ τοιαῦτα ἐν ἀλλήλοις, καὶ μὴ γίγνεται
ἀλλ' ἐκκρίνεται ἐνόντα, λέγεται δὲ ἀπὸ τοῦ πλείονος, γίγνεται δὲ
ἐξ ὅτου ὅτι οἶον ἐκ σαρκὸς ὕδωρ ἐκκρινόμενον καὶ σὰρξ ἐξ
ὑδατος), ἅπαν δὲ σῶμα πεπερασμένον ἀναιρεῖται ὑπὸ σώματος πεπε-
ρασμένου, φανερόν ὅτι οὐκ ἐνδέχεται ἐν ἐκάστῳ ἕκαστον ὑπάρχειν.
ἀφαιρεθείσης γὰρ ἐκ τοῦ ὑδατος σαρκὸς, καὶ πάλιν ἄλλης γενομένης
ἐκ τοῦ λοιποῦ ἀποκρίσει, εἰ καὶ αἰεὶ ἐλάττων ἔσται ἡ ἐκκρινομένη,
ἀλλ' ὅμως οὐχ ὑπερβαλεῖ μέγεθος τι τῇ μικρότητι. The transla-
tion is that of W. Charlton, Aristotle's Physics I, II (Oxford:
Clarendon Press, 1970), p. 9.

abundance; and if anything can come to be out of anything, for instance water be separated out from flesh, and flesh from water; and if only a limited quantity of stuff is needed to do away with a limited quantity of stuff: it plainly follows that everything cannot be in everything. For suppose that some flesh is removed from some water, and then more flesh extracted from what remains: even if the yield is lower each time, there will still always be some quantity smaller than any yet yielded."

Aristotle is here replying to the teaching of Anaxagoras which implies that there is no minimum size for things like flesh and bone. What Aristotle has established in the first sentence of this passage is that for any part of an animate body (such as flesh or bone) there is a maximum size above which and a minimum size below which it cannot go and still be the flesh or bone of an animate body. In the direction of largeness, he contends in effect that we cannot suppose that there is, for example, a hundred-foot bone which is still the bone of an animal, for there is obviously an upper limit to the size of any given animal. That is clear enough. But there is also a lower limit--and this he uses against Anaxagoras. What Aristotle evidently has in mind is that as one continually bisects a piece of bone, eventually one will reach a point at which the two halves resulting from the bisection will be too small to be bone. Likely the latter two halves will be simple or elemental bodies--earth, air, fire, and water.⁹¹ But here

⁹¹Ross, Physics, p. 486, says that this is not to be taken as a contradiction of the doctrine of infinite divisibility, but only that there is a lowest limit to the size of a portion of flesh. Charlton, op. cit., p. 65, suggests--I believe rightly--that there is a point in division at which one arrives at elemental bodies.

there is no hint that the bisection might not thereafter be able to continue, ad infinitum.

Physics 6.10, 241a33-b2:⁹²

"The limit of increase is the complete magnitude answering to a thing's proper nature; the limit of diminution is the loss of this."

This passage makes approximately the same point that the previous passage from the Physics made: a man, for example, can only increase or decrease within upper and lower limits and still retain his essential nature as a man.

On the Soul 2.4, 416a15-18:⁹³

"For the increase of fire is indefinite as long as there is material to be burned, but of all the things formed by nature there is a limit and a [proper] ratio of both their size and their increase; and these are marks of soul, but not of fire; they belong to ratio rather than to matter."

Here Aristotle is replying to the view that the nature of fire is simply the reason why nourishment and growth take place; and he says in reply that we must also have a reason for growth into a certain form and limit, and fire alone as matter does not supply an adequate reason for growth in a certain way. Fire alone as matter has no limit on size or increase, whereas complex (συνισταμένων--416a16) natural substances do.

In none of these passages is it supposed that any magni-

⁹² αὐξήσεως μὲν γὰρ τὸ πέρας τοῦ κατὰ τὴν οἰκείαν φύσιν τελείου μεγέθους, φθίσεως δὲ ἡ τούτου ἔκστασις. The 'translation' is Ross' 'analysis' in his Aristotle's Physics, p. 418.

⁹³ ἡ μὲν γὰρ τοῦ πυρὸς αὐξήσις εἰς ἄπειρον, ἕως ἂν ᾗ τὸ καυστόν, τῶν δὲ φύσει συνισταμένων πάντων ἔστι πέρας καὶ λόγος μεγέθους τε καὶ αὐξήσεως. ταῦτα δὲ ψυχῆς, ἀλλ' οὐ πυρὸς, καὶ λόγου μᾶλλον ἢ ὕλης.

tude is physically indivisible at some point. The only thing that they do seem to indicate is that for some things--complex physical objects--there is a lower limit to their size, if they are indeed to remain what they are. And it seems as well implied that there is no such limitation on the 'simple bodies'. And this is substantiated by a passage from On the Heavens 3.3, 302a15-18; there Aristotle defines the nature of an 'element'. It is "that into which other complex bodies are divisible and is present in the latter either potentially or actually; . . . but the element itself cannot be divided into parts differing from itself in kind."⁹⁴ This certainly implies that such a 'simple body' can indeed be constantly divided into progressively smaller parts without limit.

Aristotle's Criticism: 'What is' has many meanings

Aristotle has thus quite rightly shown that in one respect Democritus' reasons--the problem involved in 'divisible everywhere'--for positing atoms and relegating phenomena to an illusion were totally inadequate. But Democritus also had a second reason for his rejection of the phenomenal object as real, and this was the appearance of contraries in the same phenomenal object. This had led him to accept an Eleatic absolute sense of 'is' for his atoms (along with a similarly ab-

⁹⁴ ἔστω δὲ στοιχεῖον τῶν σωμάτων, εἰς ὃ τὰλλα σώματα δι-
αίρεται, ἐνυπάρχον δυνάμει ἢ ἐνεργείᾳ . . . αὐτὸ δ' ἐστὶν
ἀδιαίρετον εἰς ἕτερα τῶν εἶδει. Similarly at Metaphysics 5.3,
1014a31-34, where Ross, Metaphysics, I, 294, rightly says:
"the physical elements . . . are only divisible into μόρια
ὁμοειδῆ."

solute sense of 'what is not' for his void).⁹⁵ The atom is the only thing that really exists; it simply always is and remains the same, not in itself subject to any change. And on this count too Aristotle shows that Democritus' positing of atoms and rejection of the phenomenal object was completely unwarranted.

To take up first the atomist acceptance of an absolute sense of 'is', Aristotle points out at Physics 1.3, 187a1-10 (the very passage in which he had said that the atomists yielded to Eleatic arguments) that this not only unduly limits the meaning of 'is', but also makes it unintelligible. Aristotle points out here that 'is' may be used in two senses, an 'absolute' and a 'particular' sense--'x does not exist' and 'x is not some particular thing'--and there is a real difference between the two senses. "For," Aristotle says, "even though 'what is not' cannot be without qualification [simply exist], there is no reason why it might not refer to something which 'is not some particular thing'."⁹⁶ Indeed, Aristotle goes on to imply, 'what is' in itself is unintelligible apart from being some particular thing.⁹⁷

⁹⁵Metaphysics 1.4, 985b5-7; 4.5, 1009a27-30; Physics 1.5, 188a22-23.

⁹⁶Physics 1.3, 187a5-6: οὐθὲν γὰρ κωλύει, μὴ ἀπλῶς, ἀλλὰ μὴ ὅν τι εἶναι τὸ μὴ ὄν.

⁹⁷Physics 1.3, 187a8-9: τίς γὰρ μανθάνει αὐτὸ τὸ ὄν εἶ μὴ τὸ ὅπερ ὄν τι εἶναι; "For who understands 'what is' by itself except precisely in the sense that it is some particular thing?"

Aristotle again takes up the meaning of 'is' with more specific reference to Democritus in Metaphysics 4.5. There, immediately after his statement that Democritus posited 'the full' as 'what is', Aristotle takes up this two-fold meaning of 'what is': "in one way they are correct, but in another way they are in error, because 'what is' has two meanings."⁹⁸ These two meanings evidently refer to the two senses of 'what is' referred to in Physics 1.3, that is, 'simply exists' and 'is a particular thing'.⁹⁹ Thus there is one way in which something can come into being out of 'what is not', in the sense that something can come into being out of 'what is not that particular thing', but is some other thing. For example, a red apple can come into being out of what is not a red apple, but is a green one; or, air can come into being out of what is not air, but is water. On the other hand, this is not true of the other meaning of 'is' ('simply exists'), for nothing can come into being out of what does not exist at all (1009a32-33). Thus Aristotle has shown that there is no need or justification for restricting the meaning of 'what is' to only one meaning; and in the sense of 'what is some particular thing' it has as many senses as there are things to which it can refer.

Thus, having established the two meanings of 'what is'

⁹⁸ Metaphysics 4.5, 1009a31-32: τρόπον μὲν τινα ὁρθῶς λέγουσι τρόπον δὲ τινα ἀγνοοῦσιν· τὸ γὰρ ὃν λέγεται διχῶς.

⁹⁹ Ross, Metaphysics, vol. 1, ad loc., says nothing in his commentary about the two meanings of 'what is'; his 'Analysis', p. 273, indicates that he believes the two meanings are 'is potentially' and 'is actually'.

and the application of the former--'what is some particular thing'--to the phenomenal world, Aristotle goes on to introduce the concepts of 'potency' and 'act' and use them to help clarify the difficulty about contraries in the same object (1009a33-36). For, he says, using the former sense of 'what is', the same thing can simultaneously both be and not be; for example, a green apple can both be (a green apple) and not be (a red apple); it cannot, of course, both 'be' and 'not be' simultaneously in the same respect. For the same apple cannot be both a green apple and a red apple at the same time in actuality; but it can at the same time be actually a green apple and potentially a red apple. Thus it is quite reasonable for the same object to be two contraries, as long as it is not actually both at once. This also means, Aristotle implies, that the atomists had no good reason for contravening empirical evidence because of the appearance of contraries in an object.

Concluding Remarks

The atomists, Aristotle says, had rightly started with empirical evidence and had indeed attempted in some degree to account for it and preserve it. But, in spite of their proper beginning, they felt compelled to relegate the phenomenal object to the realm of illusion and to posit indivisible bodies as that which really is. The grounds on which they felt justified in making these claims were that they felt that such a claim was the only reasonable way to solve two problems: the problem of 'divisible everywhere' and the problem of 'contra-

ries in the same phenomenal object'. Both problems seemed to them to point to the fact that the phenomenal object was to be distinguished sharply from the physical object. The problem of division led them to posit atomic bodies in order to save the physical object from the same sort of annihilation which they felt the phenomenal object had already suffered by being divided to nothing. The problem of contraries led them similarly to posit atoms and void as that which 'is' and that which 'is not' to account for the contraries in phenomenal objects.

But Aristotle, as we have now seen, has quite cogently pointed out that both their reasons were not valid ones. Division everywhere does not annihilate anything; and contraries in the same object can be quite reasonably explained without resorting to unwarranted speculation. In regard to both these problems the concepts of 'potency' and 'act' had shown the way in solving them. These concepts had clarified the distinctions between the two meanings of 'divisible everywhere'; and Aristotle had shown that the 'infinite' in 'infinite bisection' is a potency which in the very nature of the case cannot be actualized. 'Potency' and 'act' had likewise provided a reasonable solution to the problem of contraries in the same object.

CHAPTER II

THE PROBLEM OF PLACE

Introduction

A direct corollary to the assumption that there are immutable atomic bodies, that is, that there is no true unity in physical objects, is the theory that there is a void, an empty place in which and into which these atomic bodies can move, a void which keeps them wholly distinct from one another, even when they congregate to form physical objects. Both theories, both of the atoms and of the void, together were formulated in response to Eleatic doctrine; and so, in a certain sense, the two theories are really two aspects of the same theory. And we might thus have considered them together under a single topic, for there are difficulties which Aristotle raises which both these theories share. But, on the other hand, there are also certain problems and difficulties which attach to each of these theories and concepts as distinct from one another; and in this respect Aristotle is quite right in giving separate consideration--at Physics 4.6-9--to the problem of the void. And so we may also deal separately with this theory and with Aristotle's objections to it.

We have already dealt with the vocabulary of the void to a certain extent when we dealt with the terminology used for

the atoms, for the atoms and the void are defined and described as absolute contraries to one another. The atom is that which is solid and full (στερεόν, πλήρες); it is, in the absolute sense of the term, 'what is' (τὸ ὄν);¹ it is the only thing of which we can really have any direct and positive experience. The void is the only other 'thing' which, according to Democritus, there is in the same, absolute sense of 'what is'. And it, in contrast to the 'full' atom is that which is 'empty' (τὸ κενόν).² This void, as a 'thing', is intended to be a direct contrary to the atoms; whatever the atoms are, it is not that. As the atom is absolutely solid, full, and impassible, the void is absolutely empty and passible. Whatever else one might say about Aristotle's going out of his way to search out contraries in the Presocratics and finding them even in Eleatic doctrine,³ he is certainly right in finding them here in Democritus, for here they are quite distinct and quite primary. And, inasmuch as the atom is 'what is', the void is 'what is not' (τὸ μὴ ὄν)--a term which was very likely used by Democritus himself, in that his atoms and theory of the void were both formulated in response to Eleatic thought. He also probably used the pair of contrary terms cited in the first chapter (pages 18-19): 'thing' and 'no-thing' (ὄν, οὐδέν).

Democritus' quite consistent claim is that both of these

¹Physics 1.5, 188a19-24; Metaphysics 1.4, 985b4-10.

²Ibid.

³Cherniss, op. cit., pp. 52-52, makes this charge.

contrary 'things' exist equally, the one as much as the other. And this is certainly a consistent claim, for the one implies and almost necessitates the other, so much so that, as we shall see, Aristotle's arguments against the void at times overlap and duplicate his arguments against Democritus' atoms.

In summary, Aristotle's primary objection to a void as some separately existing 'thing' is that of making a noun or substance out of what is obviously an adjective or attribute, a property of body--extension. We might tentatively distinguish the ways in which Aristotle proceeds to raise this basic objection and in this way organize what he has to say about the problem. In the first place, Aristotle objects to the void as something internal to physical objects; as something internal to them it not only keeps the parts of the object separate and keeps them from forming a true unity,⁴ but also, although the void was supposed to explain the expansion, compression, and weight of physical objects, it fails to do this adequately. Secondly, the void, as something external to physical objects, offers only a 'material' explanation of the motion of atoms and nothing more than that; it leaves unanswered the question, important to Aristotle, as to whether their motion is natural or constrained;⁵ it offers nothing but a mechanistic explanation

⁴In this respect we have already considered Aristotle's objections in connection with the concept of the atom--a failure to account for the true unity of any physical object.

⁵This question, as we shall see, will only receive some kind of satisfactory answer when we consider the question of 'cause' and 'necessity' in the fourth chapter.

of the proper place and motion of physical objects, and, at that, an inadequate explanation. And finally, but most importantly, the assumption of its existence rests on an intrinsically unverifiable supposition that one can abstract qualities from bodies and assume that such qualities can exist apart from the body from which it was abstracted; and this, in turn, is connected with a misunderstanding of what meanings 'what is' and 'what is not' can have.

Criticism of the 'Internal Void'

Now, as we take up these objections individually, we may consider first the difficulties which Aristotle raises against a void that is considered as 'internal to physical objects'. By a void 'internal to physical objects' we shall mean that void, that empty space, which is within the outer limits of what we call a physical object--the empty space in the object in which its constituent atoms move and clash and rebound. That void may be considered a 'part' of the whole physical object, and thus, in a sense, not separable from that object.

For one thing, such a void would keep the object from being a truly unified object. The principle of atomism by itself, as we have seen, provides sufficient grounds for raising this objection; and now the principle of the internal void provides even further grounds.

At Physics 3.4, 203a20-23 Aristotle attributes to Democritus (and to Anaxagoras) a teaching which amounts to saying that that which is boundless is continuous by contact: τῆ δὲ φη

συνεχὲς τὸ ἄπειρον φασίν.⁶ This is obviously meant by Aristotle as a Democritean description of the universe as a whole, without any specific reference to physical objects. But the situation in the universe as a whole is no different in principle from what is true of physical objects,⁷ for the latter also have void within them.

And that this void is there within those objects is shown by the fact that Aristotle explains at On Generation and Corruption 1.8, 326a1-3 that for the atomists 'being affected' (πάσχειν) occurs to a physical object only through the void. Furthermore, all the atoms in a physical object are obviously not everywhere in contact with each other; if they were, Aristotle would not in this same work (1.9, 327a8-10, 24-26) have

⁶Cherniss, op. cit., p. 27, note 104, uses this citation to show that Aristotle was presenting arguments against atomism both at On the Heavens 1.7, 274b18-22 and at Physics 3.5, 204a34-b22. But this hardly seems likely. In the former passage Aristotle is talking about corporeal elements (σῶμα is used at both 274a30 and b19); each of two or more such corporeal elements, he says, cannot be infinite. In the Physics Aristotle is again talking about corporeal elements (ἐπισκοποῦμεν περὶ τῶν αἰσθητῶν --204b2--and the constant repetition of σῶμα seems to bear this out); indeed, in the whole course of this particular argument he is not considering the void at all, for at least at one point in the argument (205a35-b1) one of the unthinkable alternatives would be: ἡ γὰρ κενὸν ἔσται τι. The void presents special difficulties of its own, since any void can be filled with a body.

Aristotle does indeed object to infinite extension itself, but primarily on the grounds of its being beyond any comprehension; but this is another matter.

⁷Man, or any living creature, is apparently described by Democritus as a 'universe in miniature'--compare Diels-Kranz 68B34. The same is likely to hold for any and all physical objects: they are alike in that they are a composite of atoms and void; and it is in this respect that they resemble the universe.

raised the objection to the atomism of Democritus that with such atoms the physical object does not change 'as a whole'-- that is, when one atom is affected, they all are.

Indeed, the void in physical objects is precisely that which keeps the units or atoms separate and distinct, and thus keeps the physical object from being a true unity. And in fact Aristotle at Physics 4.6, 213a33-34 explicitly attributes to Democritus a concept of the void which does exactly that: it divides (or, 'takes apart') any whole physical object and keeps it from being a continuous whole.⁸ The refutation of the void as having this characteristic (that of breaking up the unity of things), which is essentially the same as that characteristic which it has for the Pythagoreans, does not lie in the general objection which Aristotle raises against the concept of the void at 4.7, 213b31-214a11,⁹ but in the arguments which he raises against those atomistic thinkers who would deny the essential unity of physical objects, the very arguments we have already examined in the first chapter of this

⁸ ὁ διαλαμβάνει τὸ πᾶν σῶμα ὥστε εἶναι μὴ συνεχές. It is interesting to note at this point that, as the teachings of Democritus and the Pythagoreans were indeed alike inasmuch as they constructed objects out of the smallest possible units (atoms, numerical units), so their doctrine of the void is alike inasmuch as it separates things both in the universe at large and in individual objects. See Physics 4.6, 213b23-29, especially 26-27, where void for the Pythagoreans separates the numerical units: καὶ τοῦτ' εἶναι πρῶτον ἐν τοῖς ἀριθμοῖς· τὸ γὰρ κενὸν διορίζειν τὴν φύσιν αὐτῶν.

⁹ Compare Cherniss, op. cit., p. 148, who says that this is the only criticism involved; he further says that this criticism holds only against the Pythagoreans; but their view is like Democritus' in this respect; hence both are liable.

paper.

At Physics 4.6, immediately after mentioning Leucippus' and Democritus' theory of the void as that which is internal to physical objects and as that which thus breaks up their unity, Aristotle presents three (or, perhaps, four) arguments which they¹⁰ use to support the positing of such a void, and then he adds a special Pythagorean version of the doctrine of the void, which in certain respects is quite like that of the atomists. The first of these arguments is that the void is a necessary condition for locomotion.¹¹

Immediately thereafter there follows at 4.6, 213b14-18 a second argument for the void based on empirical evidence, that physical objects obviously do compress and contract. The proponents of the void hold that the ability of objects thus to compress is due to an internal void (τὰ ἐνόντα κενά) in the object to be compressed. The illustration cited is that of wine taken from a jar, put into skins, and then put back into the jar along with the skins--there now being room for both

¹⁰ Apparently Leucippus and Democritus primarily are meant here, although they are not specifically mentioned. Cherniss, op. cit., p. 150, assumes that the reference is to these atomists, and there seems to be no compelling reason for saying that he is wrong. Indeed, as we shall see, though Cherniss feels that at least one of the arguments in Aristotle's refutation does not really affect the atomist position, all--except those directed against a sort of void which is substantially air--are quite appropriate.

¹¹ This matter will be taken up presently as a separate item, although the following arguments taken up here do involve the locomotion or positioning of the atoms within physical objects.

wine and skins in the same amount of space; there is no apparent qualitative change in the wine and no apparent change in the amount of wine.

Against this Aristotle argues at 4.7, 214a32-b1 that it is not a necessary explanation,¹² that other explanations of this phenomenon are certainly possible without resorting to a non-empirical void. Aristotle's own explanation of this phenomenon is that part of the contents are squeezed out of the wine when it is compressed, just as when water is compressed and extrudes some of the air in it.¹³ And so there is an explanation just as reasonable--and more reasonable, Aristotle would likely say--than that of a void. Hence, in this case, the void is not necessary.

A third argument, presented next at 4.6, 213b18-22 to support the contention that there is a void,¹⁴ is that the observable process of the body absorbing food and growing by

¹²214a32-33: ἐνδέχεται δὲ καὶ πυκνοῦσθαι μὴ εἰς τὸ κενὸν ἀλλὰ διὰ . . . Compare the reformulation of this refutation by Simplicius, in *Physicorum*, p. 660, lines 2ff.: οὐκ ἀνάγκη . . . δύναται γὰρ

¹³I am not sure what sort of empirical evidence, if any, Aristotle had for this latter example; all that we can say about it is that for him it very probably was formed on the analogy of squeezing the pits out of olives.

¹⁴We may indeed have here two separate arguments, each to be considered on its own merits. They will here be treated together, though hopefully without neglect of the distinctness of each. Henri Carteron, *Aristote Physique*, 2 vols. (Paris: Société d'Édition "Les Belles Lettres", 1956-1961), I, 137, presents them as a single argument. Besides, Aristotle himself takes up the reply to both at once; his answer to one he takes to be a sufficient refutation of both: ὁ δ' αὐτὸς λόγος καὶ ἐπὶ τῆς τέφρας--215b9-10.

means of it seems to require empty spaces in the body into which the food can go in order to provide increase in size in the nourished body. First there is presented the empirical fact of the growth of the physical object. That this takes place through the void is supported first formally on the grounds that, since both the nourishment and the nourished object are corporeal and the former must penetrate the latter for growth to take place, this penetration and subsequent growth must take place through the void, for two totally corporeal substances cannot occupy the same place at the same time.

This formal argument for the void is then further supported by an appeal to empirical evidence (μαρτύριον δέ--213b21): a jar containing some substantial amount of ashes (or, perhaps, some powder or chemical)¹⁵ will receive as much water as if the ashes were not there; obviously, the argument would continue, the water was absorbed into the void in the ashes--or, vice versa. If, as seems to be the case, this latter argument is part of the general argument from 'growth', then it is probably intended as a more apparent illustration by analogy of what likely goes on inside the body, showing how the food is first absorbed into the body before (or, as) it brings about actual increase.

¹⁵The solution to the problem by Eudemus, as cited by Simplicius, in Physicorum, p. 662, lines 25-29, seems to indicate that some chalky powder (τίττανος) was involved, as well as a process of burning (καίει) with some resultant vapor (ἀτμός).

Aristotle takes up the reply to this argument at 4.7, 214b2-10, showing that, of the two kinds of increase in size, the void is totally otiose in explaining the one and involves itself in further difficulties in explaining the other. In the first place, he contends, not every instance of increase in size need be attributed to the addition of some matter to the physical object; and one very clear case in point of this is the generation of air (vapor, steam) from water. Assuming that this increase in size takes place in an enclosed container and that there is thus no question of the entry of void from the outside to produce the expansion nor of the entry of anything solid,¹⁶ then there is also no question of the necessity of corporeal interpenetration through a void, for nothing new at all enters into the expanding object. Thus, for this kind of increase in size the void is not necessary; there is a better alternative explanation, better because the void is utterly useless here to explain this phenomenon.

Now at 214b33ff. Aristotle takes up the argument proper for the void in that he takes up specifically the question of growth by means of some nourishing substance, and, along with it, the question of the 'water and the ashes'; he sees both of these as parts of the same question and, in effect, answers them together.

¹⁶Some of these assumptions are taken from On the Heavens 3.7, 305b10ff., where there is a parallel account of the phenomenon of the change of water into air. The additional point is made there that the expanded vapor will burst its container--evidently an appeal to empirical evidence.

Aristotle says, first of all, that these arguments for the void involve even further difficulties.¹⁷ Assuming, he asserts, that void is to help account for the growth of a physical object by means of nourishment, one is forced to accept what amounts to one of the four alternatives which he lists: 1) the whole body does not grow, 2) the nourishment is not corporeal, 3) two bodies can be in the same place, and 4) the whole physical object is empty and void.

Cherniss¹⁸ sees in this refutation by Aristotle a paradox: if growth is to be explained by means of void in the body, then the whole body is void. And for the paradox to hold Cherniss says that Aristotle must assume three conditions, which he identifies with the first three of the above-mentioned alternatives: the body grows as a whole, nourishment is corporeal, and two bodies cannot occupy the same place. Cherniss then rejects the validity of Aristotle's argument by pointing out that the atomists do not accept the first condition--that the body grows as a whole. But this is to miss the point of Aristotle's criticism.

Simplicius' account of this passage is quite helpful not

¹⁷Cherniss, op. cit., p. 150, argues that Aristotle says that this type of an explanation by means of a void is self-contradictory. But there is no self-contradiction until one also assumes along with the theory of the void 'growth everywhere' for the physical object. But Aristotle does not say that the account is self-contradictory, but only that it is a hinderance, that it 'gets in its own way': αὐτὸς αὐτὸν ἐμποδίζει--214b5.

¹⁸Op. cit., p. 150.

only in outlining the argument, but also in showing precisely what is at issue in the argument, that is, the question of the nourishment and growth of a physical object as a whole.¹⁹ Indeed, the atomists could not on principle accept any of the latter three of Aristotle's alternatives and would likely have had no qualms about identifying the first with their position. But this first alternative, as Simplicius aptly points out, is a matter of empirical evidence; the object does grow as a whole.²⁰ So the argument against the void as accounting for

¹⁹In Physicorum, p. 661, especially lines 31-32. According to his analysis the argument seems to resolve into a series of alternatives thus:

- I. Either food is not body (Aristotle's second item), or
- II. Food is body; but then either
 - A. Growth and nourishment do not take place everywhere (Aristotle's first item), or
 - B. Growth and nourishment do take place everywhere; but then either
 - 1. Body passes through body; two bodies can simultaneously be in the same place, or
 - 2. Body passes through nothing; the nourished object is void.

Presented thus one sees Aristotle's alternatives rather as pairs of alternatives.

²⁰Loc. cit., p. 661, lines 32-33: ὅπερ ἐστὶ παρὰ τὴν ἐνάρξειαν.

Cherniss, op. cit., p. 150, points out that Aristotle's argument against the atomist position can only hold if the body increases everywhere, but that Aristotle's own theory was that there was no material increase everywhere; and he cites in support of this On Generation and Corruption 1.5, 321b22-322a4. He is quite right in this respect, but there is in fact no discrepancy between Aristotle's argument and his teaching here. There is by Aristotle's theory growth everywhere, but only in one of two senses, in the sense that the whole object everywhere (assuming a simple object) grows. But there is not increase everywhere in the sense that the particular piece of matter added to the object is distributed everywhere in that object; inasmuch as that piece of matter is distinguishable at all, it may remain as matter in one part of the object. This is not to say that the whole object does not grow everywhere,

growth reduces to an argument against those who would deny the real, continuous unity of a physical object; and precisely as such it is uniquely appropriate to the atomists' position at its very foundations; it certainly does not fail, as Cherniss says it does, to take into account those who assume minimal quanta.

The second aspect of this argument, the argument from the water poured upon some ashes, shows exactly the same weakness as the first.²¹ Neither Aristotle nor Simplicius write their reply out in detail; they do not specify their argument against the positing of the void to explain this process of absorption. Hence, if we may put it into the form of the sets of alternatives suggested by Simplicius, it goes like this:

I) either the ashes are not body at all (in which case the

but only that the piece of matter as such may not be everywhere in the grown object.

But Cherniss has neglected to cite the sense in which increase everywhere in a growing object does take place, and this might well have shown him how the theory and argument of Aristotle are not inconsistent with one another. The whole object does grow in 'form'; its form may increase like the increase in size of the arc of a circle (to use Aristotle's own example) or like a balloon being inflated or like water when more water is added; the continuous mass of matter in the object grows as more matter is assimilated to it; there is no portion in it or on it at which this growth is not evident, even though the piece of added matter may remain somewhat localized. When more air is blown into a partially inflated balloon, the whole balloon increases in size--so too does the air inside--as a continuous whole. Atomism, along with its doctrine of the void, cannot on principle account for such growth everywhere in a physical object.

²¹ Although Aristotle had a constructive solution to the example cited in the first aspect of the argument from growth to the positing of the void, he has no physical solution to the difficulty cited here; but Simplicius does provide one.

argument for the void is destroyed), or II) the ashes are body; but, if they are body and the jar receives an amount of water equal to the amount received when the jar was totally empty, then A) either the water does not penetrate everywhere in the jar (which is contrary to evidence),²² or B) it does penetrate everywhere; but, if the latter is the case, then either 1) there can be two bodies in the same place, or 2) water is not body, but empty and void; and neither of these latter two are acceptable alternatives. Thus, as in the first part of the argument 'growth everywhere' was the key issue, so it is that role which is taken up by 'penetration everywhere' in this second phase of the argument. Both are central, both seem for Aristotle to be a matter of empirical evidence, and both raise the central issue of the essential unity of the physical object; and it is on these grounds that Aristotle thus criticizes those who hold to a void--it contravenes empirical evidence.

At Physics 4.6, 213b15-18 the problem of compression was raised in connection with the difficulty about the wine, the skins, and the jars; this was a specific problem in that there was no change of quality or essence involved, and Aristotle had answered it as such and in those terms (4.7, 214a32-b2). Then

²²That this is also a matter of empirical evidence seems to be supported by a passage at On the Heavens 3.8, 306b9ff. Aristotle is there talking about the elements having specific shapes, and he refutes this notion by claiming that evidently (φαίνεται) water accommodates itself to the shape of its container and fills it everywhere as a continuous whole: οὐ γὰρ ἀν' ἡμετέρο πανταχῇ τοῦ περιέχοντος τὸ ὅλον. Water is also used to illustrate the unity of parts in a true combination as a continuous whole at On Generation and Corruption 1.8, 326a33ff.

immediately thereafter the specific problem connected with 'growth' and the void had been raised (4.6, 213b18-22); and Aristotle in his reply and analysis of this problem had first raised and then given a preliminary answer to what he felt was the more general problem--that of increase in general (4.7, 214b2-3)--before replying (214b3-10) more specifically to the argument that had been raised; and at that point he does not say much more about the general problem of change.

But Aristotle rightly sees that there is considerably more at stake here than specific answers to specific arguments, for these specific answers and arguments have not yet really gotten to the heart of the matter. Indeed, these specific arguments do in principle raise the larger question of the role of void in the expansion and contraction of physical objects in general, and it is this larger question which Aristotle takes up at Physics 4.9.²³ And the specific form that this larger question takes is whether recourse to the void is the only feasible one of a set of alternatives, that is, whether void is necessary to explain expansion and contraction: ἡ κενὸν εἶναι ἐξ ἀνάγκης· συμπιλεῖσθαι γὰρ καὶ συνεπεκτείνεσθαι οὐκ ἐνδέχεται ἄλλως.²⁴ Now for Aristotle the basic meaning of 'necessary' seems to be that there is no other

²³Cherniss, op. cit., pp. 153-154, argues that Aristotle's criticisms do not actually meet the special arguments for this thesis, but falls back on the fact that the void does not explain natural motion. As we proceed it will hopefully that Aristotle does meet them and how he meets them.

²⁴216b28-30.

feasible alternative, that it simply cannot be otherwise and still make sense: τὸ μὴ ἐνδεχόμενον ἄλλως ἔχειν.²⁵ And this is precisely what Aristotle intends to show about the 'necessity' of the void, that, as an explanation, it involves further serious difficulties and that it is not the only reasonable alternative; that there is indeed another alternative which is, besides, consistent with the essential unity of physical objects.

The first argument (216b30-33) against such an explanation of expansion and contraction in terms of the void is that internal void, inasmuch as it is conceived as something separate and distinct, labors under the same difficulty as the void in general does, namely, that it is--as pure extension--an unwarranted abstraction of a property that we perceive only in connection with physical objects. This criticism is an important one and will be taken up separately later.

Secondly, if the void here is, on the other hand, not conceived of as something separate from physical objects, not something distinct, but is still in and part of physical objects in some sense,²⁶ then it cannot explain any kind of change at all, including expansion and contraction, for it will

²⁵ Metaphysics 5.5, 1015a34. This Aristotle says is basic to all the other senses in which 'necessary' is used: κατὰ τοῦτο τὸ ἀναγκαῖον καὶ τὰλλα λέγεται πως ἅπαντα ἀναγκαῖα--1015a35-36.

²⁶ Simplicius, in Physicorum, p. 684, lines 24-25, describes this as that which disperses throughout the object in small bits, but is still not separate from the object: κατὰ μικρὰ ἐνεσπαρμένον . . . καὶ μὴ χωριστοῦ.

thus not be that in which (or, into which) movement occurs: κινήσεως αἴτιον οὐχ οὕτω τὸ κενὸν ὥς ἐν ᾧ --217a1-2. Indeed, under those conditions there is only one type of change that it could explain, and that with a little more reasonableness, and that is the upward motion of physical objects: οὐ πῶς κινήσεως αἴτιον . . . ἀλλὰ τῆς ἄνω. And, as Aristotle goes on to point out, it does not even do a sufficiently adequate job of that.²⁷ Aristotle is here certainly not simply falling "back upon the thesis that it cannot explain natural motion."²⁸ He insists that the argument is part of a disjunction:²⁹ either the void is conceived of as something separate or not. Under the first alternative there is the difficulty about void being an unwarranted abstraction, and in the second there is the difficulty that it fails to be able to explain that which it was intended to explain.

Having thus shown that the theory of the void is untenable on either one of the two alternatives just mentioned, Aristotle now proceeds to show that it is indeed not necessary, that it is not the only feasible alternative to account for expansion and contraction. These can be explained much more reasonably, Aristotle feels, in terms of a single matter cap-

²⁷ This criticism will be taken up separately in the next section in conjunction with the question of the void as an explanation of motion.

²⁸ Cherniss, op. cit., p. 154.

²⁹ εἰ μὲν . . . εἰ δέ--216b30-33.

able of contrary qualifications and in terms of potency and act. There will in this way be change, the universe will not absurdly bulge (as some had apparently supposed would be the only alternative to the void), and there is thus no need for an unwarranted void. This sort of account which Aristotle offers as a counter-proposal will then more fully and adequately explain the expansion of water into air and the contraction of air into water. Water, actually of a given volume, is potentially larger; and it is quite evident (δῆλον δέ--217a27) that this must be the case, for when water changes into air, it does so by retaining the same matter, by not taking on anything else in addition.³⁰ And not only does this do a better job of explaining the phenomenon without encountering the above difficulties, but it also has the added advantage of accounting as well for the real unity of the physical object and the real identity of that whole object as it undergoes some change in quality (e.g., becomes hotter): ἐστὶ τὸ αὐτὸ πυκνὸν καὶ μανόν. καὶ μία ὕλη αὐτῶν --217a10-11. And both the unity, as we have seen, and the identity of such a physical object are given in empirical evidence.

The Internal Void and Locomotion

Aristotle has thus far shown that void is not necessary to explain the types of 'motion' which, by Aristotle's own

³⁰217a27-28: ὅταν γὰρ ἐξ ὕδατος ἀήρ γένηται, ἡ αὐτὴ ὕλη οὐ προσλαβοῦσά τι ἄλλο. Evidently this means taking on neither additional matter nor any additional void.

standards, may be classified as not directly involving the locomotion of physical objects, primarily increase and decrease. But it is of the essence of atomism to reduce all types of movement to locomotion. And so Aristotle must deal specifically with that question. And this he takes up early in his discussion of the reasons for positing the void to explain movement in general.

The Eleatics had argued that there is no real motion, for 'what is' is 'one and immoveable' and that motion is impossible without a void. 'Void', they argued, is 'what is not' and hence does not exist at all. The atomists conceded to the Eleatics that motion is impossible without a void, but proposed that 'what is not' does nevertheless exist.³¹ Motion, for the atomists, was a matter of empirical evidence and could only, they felt, be explained by positing an existing void. Thus the atomist argument for the existence of the void rests basically on the empirical fact of motion: since there is obviously motion, there must be void. Void is a necessary condition for motion and is precisely that in which such motion must occur: ἐν ᾧ κινεῖται --Physics 4.7, 214a25.

But, as Aristotle rightly points out, void is not a necessary condition for motion: οὐδεμία δ' ἀνάγκη, εἰ κίνησις ἔστιν, εἶναι κενόν--214a26. And in this respect the Eleatics

³¹Gen. et Corr. 1.8, 325a25-28: [Λεύκιππος] ὁμολογήσας . . . τοῖς δὲ τὸ ἐν κατασκευάζουσιν ὡς οὐκ ἂν κίνησιν οὖσαν ἄνευ κενοῦ τό τε κενὸν μὴ ὄν, καὶ τοῦ ὄντος οὐδὲν μὴ ὄν φησιν εἶναι. For evidence of a similar nature of the influence of Eleatic arguments, see Physics 1.3, 187a1-3.

--and Melissus in particular--were wrong (Μέλισσος ἔλαθε
 --214a27-28) when they argued that motion was impossible without a void. And so the atomists' justification for positing a void is weakened.

In the first place, Aristotle points out, motion in general (not restricted to locomotion) certainly does not require a void, for 'alteration' is quite possible without a void: ἀλλοιοῦσθαι γὰρ τὸ πλήρες ἐνδέχεται --214a28. Secondly--and here the argument specifically affects the atomists' position--void is not even a necessary condition for locomotion; it is, he argues certainly possible to explain locomotion without resorting to the positing of void or empty space; one can explain locomotion simply by positing a circular interchange of parts in motion.³² And so void is not necessary to explain either motion in general or locomotion in particular.

Furthermore, Aristotle claims, there is empirical evidence (ὁῦλον--214a31) for the occurrence of locomotion in full and continuous substances (τῶν συνεχῶν--214a31-32); he cites the example of liquids. Liquids are seen to be continuous substances, filling every part of their containers. Eddies, circular movements, evidently occur in such continuous liquids. And so in these cases at least we have evidence of the occurrence of locomotion without entailing a void into which the

³² 214a29-31: οὐδὲ τὴν κατὰ τὸν τρόπον κίνησιν. ἅμα γὰρ ἐνδέχεται ὑπεξίεσθαι ἀλλήλοις, οὐδενὸς ὄντος διαστήματος χωριστοῦ παρὰ τὰ σώματα τὰ κινούμενα.

It might be validly contended that motion could not begin in a plenum, but it can certainly be there.

moving parts of water must move. Thus empirical evidence confirms the fact the void is not necessary for locomotion. And the atomists' positing of void as a necessary condition for motion is thus unwarranted.

In what sense then is the void to explain the locomotion of physical objects? It may do so, as was pointed out earlier, only in one of two conceivable ways: as something separate from corporeal substance (as that in which movement takes place), or as something internal to physical objects (in some sense not conceived as apart from them). Since we have been dealing thus far with the 'internal void', we take up the explanation of locomotion in terms of it first.

There are two major sections in which Aristotle deals specifically with this problem: Physics 4.9, and On the Heavens 4.2.³³ An internal void can account for the locomotion of a physical object only as an explanation of its weight. And, since the void by definition has absolutely no heaviness,³⁴ it can explain only either the 'natural upward movement' of physical objects or their relative lightness--that is, the fact that object A is lighter than object B.

The case against the former of these two views Aristotle

³³Cherniss, *op. cit.*, p. 211, note 253, rightly points out that On the Heavens 4.2, 308b30-309a18 is talking primarily about complex bodies, and that the question of the weight of the individual atoms is not specifically mentioned at this point.

³⁴Physics 4.7, 214a2-3: κενόν, ἐν ᾧ μηδέν ἐστὶ βαρὺ ἢ κοῦρον.

presents first at Physics 4.9, 216b35ff.³⁵ If an internal void explains the natural upward motion of objects, as inflated skins raise nets in the water,³⁶ then void must have a motion of its own (which is impossible) and a distinct void to which it (the void) naturally moves (which is absurd); it will leave unexplained a natural downward motion (since, in that case, all things are moving upward at different speeds).

Furthermore, at On the Heavens 4.2, 309b17ff. Aristotle raises the objection that, if the internal void is like the external, all void would then move upward and all solid downward; and so there is nothing to keep the solid and the void from being and staying totally separate. Indeed, if the void is to have natural movements and, as the proportion of void in an object increases, its speed increases, it follows then that separate void ought to move at an absolute speed (which is inconceivable and thus again impossible).³⁷ Thus it is in this sense that void cannot explain locomotion. By itself this argument of Aristotle's does not render the supposition of a void untenable, but it has at least shown in Aristotle's view that void fails to explain motion and weight in one way. It

³⁵Although this apparently does not directly affect Democritus, still it seems best to include it, for the argument against Democritus' void gains effectiveness by its inclusion; it shows that Aristotle is in fairness attempting to exhaust all the possibilities, that there is no sense in which the void necessarily and adequately explains motion.

³⁶Ross, Physics, ad loc., p. 593.

³⁷Physics 4.9, 217a6ff.

is further only a part of Aristotle's refutation, the whole of which will show that there is no way in which it can explain motion.

Aristotle has thus shown that the void of the atomists cannot explain the movement of an object, in that it 'causes' the 'natural upward movement' of that object. And he further maintains that such void cannot account for the 'relative weights' of objects, that is, that one object is lighter (or heavier) than another. Besides, such an explanation of the 'relative weights' of objects in terms of the void which they contain involves one in contradicting empirical evidence.

This matter of relative weight is taken up at On the Heavens 4.2, 309a1ff. Aristotle readily admits that those who posit solid atoms (in contrast to those who claim that things are made up of geometrical figures--ἐπίπεδα) are better able to account for the relative weights of various physical objects. For example, the atomists quite reasonably and consistently propose to explain the fact that A is lighter than B, quite apart from their bulk--indeed, even when A is larger than B--by saying that A has more void than B.³⁸ Thus 'more void' is for them in all cases the explanation or cause (both αἴτιον and διὰ τοῦτο are used) of less weight in any given physical object. But, as Aristotle says, this sort of account is not

³⁸This can be put into the form of a syllogism (and Aristotle is likely to have thought of it in those terms) as follows, with the 'middle term' as 'cause' or 'explanation': A has more void; more void means lighter; and therefore A is lighter.

precise enough to explain adequately even the relative weights of physical objects. In order to give this type of explanation the precision it requires, one must say that A is lighter than B not only because A contains more void, but also, one must add, because A contains less solid matter than B. Failure to make that addition will involve one in the absurd consequence that a large amount of gold, because it contains more void, is lighter than a small amount of fire.³⁹ All instance of A containing more void than B do not coincide with those in which A is lighter than B; thus, Aristotle remarks, Democritus' explanation fails, because of its lack of precision, to explain relative weight.

Furthermore, even granting such precision, Aristotle shows at On the Heavens 4.2, 310a1-15 that Democritus' explanation in terms of atoms and void cannot adequately account for the phenomenon of 'absolute weight', the tendency of some bodies to move in a given direction, as fire moves upward naturally and earth moves naturally downward. Aristotle has shown at Physics 4.9 that void cannot be a positive factor in the upward motion of things; and he repeats that argument here in On the Heavens.⁴⁰ But, if void has no positive influence in

³⁹W. K. C. Guthrie, Aristotle On the Heavens (Cambridge: Harvard University Press, 1960), p. 336, note a, rightly explains against Stocks that there is no question here of the ratio of solid to void in a given physical object.

⁴⁰4.2, 309a33-b29; Aristotle repeats some of the points he had made in the Physics and adds others--for example, the likelihood of the absolute separation of all void from all solid.

explaining lightness, then, although the atomists posit contraries as elements, they are no better off than those who explain weight in terms of only one natural element.

But why should this be so? Aristotle's refutation of Democritus' attempt to account for absolute weight in terms of void is as follows (310a1-14). Let us assume, as Democritus does, that there are two contraries, namely, atoms and void (310a1), and that these are to be identified respectively with that which is absolutely heavy and absolutely light.⁴¹ The difficulties with this latter part of the assumption have already been outlined by Aristotle at 309b20-29, namely, that this leaves us without an explanation of their motions (the void itself was to explain motion, and it leaves us in the unreasonable position of having to explain the motion of the void by means of the void). And so there is now no reason why these two contraries should not simply be and remain separate and distinct from one another, each in its own natural place.

And so the only feasible alternative is to remove from the void any positive influence on the weight of the physical object; and so the only real factor in the weight of physical objects will be their atoms.

But still, even granting the positive influence of both atoms and void on the weights of objects, we will still be

⁴¹I am assuming with Simplicius, de Caelo, p. 691, lines 19-21, that this is an enthymeme with the specified assumption to be supplied as part of this argument. This assumption is expressed by Aristotle earlier in the text, at 309b18-20.

without an adequate explanation of how the intermediate things between these two absolutes (that is, composite bodies) are heavier or lighter than one another (310a2-3),⁴² neither in terms of the amount of 'full' and 'void' in such an object nor in terms of a proportion of 'full' to 'void' in it. This Aristotle had already pointed out earlier in this chapter of On the Heavens; so let us take up these criticisms now.

First of all, Aristotle had said, the quantity of atoms and void in two different elements will never explain fully their differences of natural motion. This, it seems evident, becomes quite clear when one attempts to work this out in a specific instance. Assume that the natural motion of a specific element is worked out in terms of the amount of atoms over against the amount of void; a given sample amount of water will have a downward tendency measurable in terms of the excess of full over empty in it. But, if this is the case, then there will be an amount of water great enough so that the difference between downward and upward pull (that is, the numerical excess of full over void) is greater than that excess in a small amount of earth, so that--contrary to evidence--the water will be heavier than the earth. Although Aristotle nowhere explic-

⁴²Guthrie, On the Heavens, p. 340, note 3 (evidently following Alexander--Simplicius, de Caelo, p. 692, lines 12-15) explains that what is meant by the 'intermediates' here is air and water, on the grounds that two of the bodies have been accounted for. But this implies that the full and the empty are being thought of in terms of earth and fire, which hardly seems likely. It is more likely that the reference is to all four elements (or, rather, to composite bodies); see Simplicius, loc. cit., lines 21ff.

itly makes this refutation (probably because no one had ever held this hypothetical view), this seems to be the tendency of the refutation that he does make at 309a31-b2. Thus purely quantitative excess or defect will not explain the differences of natural motions of the elements.

But an explanation in terms of proportions of solid to void in the elements will not really help either, for, while it may satisfactorily account for differences between elements, it will not explain a phenomenon that occurs in connection with two different quantities of the same element. Larger amounts of the same element are seen to have faster natural motions; for example, a larger amount of earth will move downward more rapidly than a smaller amount. And, since the proportion of full to empty must remain the same in the two different amounts of the same element, proportion must fail here too to provide an adequate explanation (309b8-17).

So Aristotle has introduced all of these considerations to show that, if full and empty are simply taken as contrary principles of motion, there can be no explanation of the weights of the elements relative to one another. He now goes on to show that with such principles of motion one could not explain either the weight of these elements relative to these two absolutes, that is, to show precisely how each of the elements is heavier than the void and lighter than the full. Both full and void are absolutes (like zero), and so an atom moving through the void would have to move at an absolute

speed, which is inconceivable (Physics 4.8, 215a24-216a25) in relation to any known speed. But void as a contrary absolute must also move at an absolute speed (Physics 4.9, 217a6-10). Thus, since both are absolutes, it will be impossible to conceive or formulate any relationship between either of them and the elements.

Thus Aristotle is right when he says that an explanation of motion which takes the full and the empty as principles of motion--as absolute heaviness and absolute lightness--cannot in the end explain the relative weights of the elements.

This means that the only view open to Democritus was that any natural motion or absolute weight--and the evidence that we have for such motion and weight--was only an illusion; it means that there is no such thing as that which is absolutely light (μήθ' ἀπλῶς εἶναι μηθὲν κοῦφον--310a9-10), that objects 'move upward' because of some pressure (ἀλλ' . . . ἡ ἐκθλιβόμενον--310a10). This is exactly what Democritus had done; the very term used here (ἐκθλιβόμενον) is, with some variations, used repeatedly in an account of breathing which is specifically attributed to Democritus.⁴³ Such a view then denies natural motion and absolute weight altogether, and thus cannot in principle account for some of the phenomena which it had intended to preserve, for it must hold that a large amount of fire or air is heavier than a small amount of water or

⁴³On Breathing 4, 471b24ff., where the following forms are used: ἐκθλίβεσθαι, ἐκθλίβοντος, θλίψιν, συνθλίβον. Compare a similar account at On the Soul 1.2, 404a10-13.

earth, and this is contrary to empirical evidence, and thus impossible (310a12-14).

Thus we have seen that as an internal principle of motion the void cannot in fact account adequately for the specific examples of motion it claims to account for, nor can it in principle account sufficiently for the weight of physical objects or of the elements themselves--either in a relative or in an absolute sense of weight.

The Void Considered as Separate

We have thus far been considering the void as something internal to physical objects, as something conceived of as not separate from them; and we have seen that as such the void can not adequately account for phenomena. We pass now to a consideration of the void as something separate, as that in which things are in motion (ἐν ᾧ κινεῖται), no matter whether those things be atoms or the physical objects which are constructed from these atoms. And Aristotle will show that considered as such the void cannot account for locomotion--neither that of physical objects nor that of the atoms themselves. And he will further show that, since qualitative changes in physical objects are reduced by the atomists to the locomotion of the atoms, the void will not account also for such changes in physical objects.

But before beginning with Aristotle's criticisms it may be appropriate to point out that Aristotle seems to present a fairly consistent picture of the role of the void in the theory

of the atomists; he regularly describes it as the necessary condition of locomotion, primarily for the atoms: οὐ . . . κίνησιν εἰ μὴ κενόν.⁴⁴ He, furthermore, explicitly denies that the atomists looked upon the void as in any sense an efficient cause of motion: τοιαύτην . . . οὐδεμίαν αἰτίαν.⁴⁵ In spite of the fact that there is no evidence to support the supposition that the void is anything more than a necessary condition of motion, Guthrie seems to feel that Leucippus and Democritus looked upon the void as being something more, something more like a "positive cause of motion."⁴⁶ But, if this 'something more like a positive cause of motion' comes close to being a concept of an efficient cause or of a 'final cause'--in the sense of that place to which an atom naturally moves--then it is inconceivable that Aristotle would not only have failed to

⁴⁴Physics 4.6, 213b5; see also 4.7, 214a24.

⁴⁵Physics 8.9, 265b23-24. The reference is to a type of cause like 'Love' and 'Strife' in Empedocles and the 'Mind' in Anaxagoras. This is further supported by Simplicius, In Physicorum, p. 1318, lines 31ff.: οἱ ποιητικοὺ δὲ μὴ μνησθέντες αἰτίου.

⁴⁶Guthrie, History, II, 398-399. In speaking of the void as a sine qua non of movement he says: "I would nevertheless doubt whether it appeared so to Leucippus and Democritus" (p. 398, note 2); and then he speaks of their answer as "coming at a stage in the history of thought when the need for a positive cause of motion was entangled with the lack of a true conception of the void" (p. 399). The only evidence which he cites to support his supposition seems to be the passage in which Aristotle says that void is the cause of motion, Physics 4.8, 214b16-17: αἴτιον . . . κινήσεως. But this seems to say no more than 4.7, 214a24, where the void is αἴτιον κινήσεως οὕτως ὥς ἐν ᾧ κινεῖται. And this is the point that Simplicius, In Physicorum, p. 658, lines 16-20, and p. 664, lines 3ff., makes in discussing this issue.

mention it, but also would have said so positively that the void was not an efficient cause and that the atomists deny any kind of final cause. So, in view of the lack of any evidence to the contrary, we have no recourse but to follow Aristotle and agree that the atomists likely looked upon their void as no more than a necessary condition of motion. Nor did they need any more than that, inasmuch as they claimed eternal motion for their atoms, as Guthrie rightly points out.⁴⁷

But there is considerably more at stake here than simply the question of the locomotion of atoms; all other kinds of 'motions' of physical objects are affected as well. For the void is conceived of as separate even when it is internal to what we call physical objects; it was posited as a response of Leucippus to the argument that there could be no motion if there were no separate void, and that there could be no multiplicity without that which keeps them apart.⁴⁸ And Leucippus' response was that the void does indeed exist, that there is a radical multiplicity of atoms (ἅπειρα τὸ πλῆθος--325a30), and that there is no essential unity either of the universe in general or of physical objects. The only true unit for him is the atom, and there is no real unity apart from the unity of the individual atoms: ἐκ δὲ τοῦ κατ' ἀλήθειαν ἑνὸς οὐκ ἂν γενέσθαι πλῆθος, οὐδ' ἐκ τῶν ἀληθῶς πολλῶν ἓν --325a36-37. That

⁴⁷History, II, 399.

⁴⁸Gen. et Corr. 1.8, 325a4-6: κινηθῆναι δ' οὐκ ἂν δύνασθαι μὴ ὄντος κενού κεχωρισμένου, οὐδ' αὖ πολλὰ εἶναι μὴ ὄντος τοῦ διεφροντος.

separate void in which the atoms move the atomists felt was essential to their explanation of the generation of physical objects and their passing away;⁴⁹ and they used it to explain every other kind of alteration of physical objects.⁵⁰ All motions are reduced by the atomists to the locomotion of the atoms in the void: "none of the other types of motion (except locomotion) belong to their primary bodies, but only to those objects composed of them, for they say that things increase and diminish and are altered (ἀλλοιοῦσθαι) as atomic bodies join or separate" (Physics 8.9, 265b27-29). Thus a successful refutation of a separate void as an explanation or as a necessary condition of the motion of the atoms is a refutation as well of any explanation of all types of motion as posited by the atomists.

We have so far, in connection with conceiving the void as internal to physical objects and in some sense not separable from them, seen that in Physics 4.6-7, although the atomists thought that void is necessary for locomotion, Aristotle validly contends that void is necessary neither for locomotion⁵¹ nor for an explanation of such phenomena as compression, expansion,

⁴⁹Gen. et Corr. 1.8, 325a32-b5: καὶ συνιστάμενα μὲν γένεσιν ποιεῖν, διαλυόμενα δὲ φθορὰν . . . διὰ τοῦ κενοῦ γινόμενης τῆς διαλύσεως καὶ τῆς φθορᾶς

⁵⁰Gen. et Corr. 1.8, 325b2-3: οὕτω πᾶσαν ἀλλοίωσιν καὶ πᾶν τὸ πάσχειν τοῦτον γίνεσθαι τὸν τρόπον.

⁵¹See Physics 4.6, 214a28ff.

and growth.⁵² We had (at page 100, above) postponed the argument and refutation of the void as explaining the locomotion of physical objects as something external and separate, for, inasmuch as the void inside of such objects is still a void in which locomotion takes place, it is for all intents and purposes separate; and, as such, will be open to precisely those criticisms which tell against any separate void--whether in the universe at large or in physical objects.

Aristotle's refutation of the atomist position on void as an explanation of motion is formulated most fully in Physics 4.8 and in On the Heavens 3.2. And here, as Cherniss rightly points out, the refutation is for the most part formulated in terms of 'natural' and 'forced' motion.⁵³ Inasmuch then as physical objects do in some sense have weight, the refutation will apply more obviously to them. But, since there is a thorny question as to whether the atoms themselves have weight, its application to them is not so clear. And so, in view of the fact of this controversy, it seems inevitable that before proceeding with the refutation we come to some sort of conclusion about the weight of the atoms and hence about the appropriateness of some of Aristotle's arguments to them also.

⁵²Physics 4.6, 213a15-21, and 4.7, 214a32-b11.

⁵³Op. cit., p. 194. Although Cherniss does say that the difficulties which Aristotle raises depend for their validity on Aristotle's concept of these two kinds of motion, I will try to show that this is not necessarily so, that the difficulties are valid, independently of the uniqueness of Aristotle's concepts of such kinds of motion.

There are two items in the doxographic tradition which seem explicitly to deny weight to the atoms of Democritus: Aetius Placita 1.3.18 and 1.12.6.⁵⁴ These statements have led various scholars to tamper with the statement of Aristotle at On Generation and Corruption 1.8, 326a9-10: καίτοι βαρύτερόν γε κατὰ τὴν ὑπεροχὴν φησὶν εἶναι Δημόκριτος ἕκαστον τῶν ἀδιαιρέτων--the most obvious meaning of which is that the weight of the atoms increases in proportion as their size increases. Cherniss, for example, interprets this as meaning that each atom has relative weight when compared to any other.⁵⁵ Both Brieger and Liepmann admit weight as an original property of the atoms;⁵⁶ Liepmann says that this weight only comes into effect in the vortex and in the world of physical objects. This is the view adopted substantially by most scholars.⁵⁷ Although Zeller argues that if they do have weight they must

⁵⁴As cited in Hermann Diels, Doxographi Graeci (Berlin: Walter de Gruyter, reprinted in 1958), pp. 285 and 311.

⁵⁵Op. cit., p. 97, note 412. Cherniss is concerned to show that Aristotle says nothing about size in regard to the weight of atoms because he does not want size as a factor in the amount of heat a spherical atom may have. But their size may be inconsequential to that particular argument in Aristotle and may have been introduced to explain the weight of the atoms. But their size too is important, though not to the argument about heat in atoms, but to the softness and breakability of atoms; the larger they are the more vulnerable to division.

⁵⁶Brieger, Die Urbewegung der Atome und die Weltentstehung bei Leucipp und Demokrit (1884); Liepmann, Die Mechanik der Leucipp-Demokritischen Atome (1885). I have not seen these works; they are cited from Burnet, op. cit., p. 345, and from others.

⁵⁷For example, Bailey, op. cit., and Alfieri, op. cit.

fall, the original fall of the atoms is likely to be a post-Aristotelian correction of atomism, and may for that reason be discounted.⁵⁸ Burnet⁵⁹ points out that Liepmann's view might be better expressed by saying that, since the weight produces no effect, it does not exist, that the concept of absolute weight as an essential attribute of body did not occur to the early physicists. Kirk⁶⁰ basically accepts this view; and this also seems to be the view of Guthrie, although he does not explicitly say so.⁶¹

In what sense then is weight to be attributed to the atoms? It certainly does not seem to function when they are simply in free motion in the void; their 'free motion' in the void is nothing but a mechanistic 'forced motion'. But even in this free motion it seems doubtful that Democritus felt that his atoms ceased to have weight simply because they did not tend to move downward. For the atoms obviously do have a weight which does function when the atoms form physical objects, for Guthrie rightly argues that otherwise Aristotle would certainly have criticized Democritus for forming heavy objects out of weightless atoms.⁶² Their weight seems to function as well in the vortex, with atoms moving by size to

⁵⁸Guthrie, History, II, 401.

⁵⁹Op. cit., pp. 342ff., especially p. 345, note 1.

⁶⁰In Kirk and Raven, op. cit., pp. 415-416.

⁶¹See his History, II, 403, 410.

⁶²Ibid., p. 403.

different positions. To suppose that the atoms had weight only on those occasions when that weight functioned might indeed have given Aristotle reason to see here an anticipation of potency and act--with the non-functioning weight being in effect a potential weight. Hence it seems more reasonable to agree more substantially with the position of Liepmann, that is, that the atoms have weight, although it does not always function. Thus these atoms can, when considered in isolation and apart from their free motion in the void, be said to have weight. Thus Aristotle's criticisms apply not only to physical objects, but in principle as well to the atoms.

Furthermore, if we accept this view, the divergence of opinion on this matter in the post-Aristotelian era might be more readily explained as being due to Aristotle's own view of weight functioning as a natural downward motion. In this way, in one sense, Democritus' atoms had weight (when considered by themselves); but again, in another sense, they did not, in that such weight did not function as the cause of an original motion, nor did it influence in any way the free movement of the atoms in the void. It is in this latter context of their movement in the void that the two passages from the Placita mention the weightlessness of the atoms of Democritus.⁶³

To return to the question of an explanation of motion

⁶³At 1.3.18 it is mentioned that Epicurus added weight as a property of atoms, ἀνάγκη γάρ, φησί, κινεῖσθαι τὰ σώματα τῇ τοῦ βάρους πληγῇ. 1.12.6: βάρος μὲν οὐκ ἔχειν, κινεῖσθαι δὲ κατ' ἀλληλοτυπίαν ἐν τῷ ἀπείρῳ.

and the role of an external void in this explanation, Aristotle's most extensive treatment of this problem and the difficulties involved in using the void for such an explanation is at Physics 4.8. The beginning of chapter eight (214b12-28) offers what Aristotle considers to be an overview of the general difficulties with positing a separate void. Aristotle considers first the question of how void can explain motion (214b13-23--this corresponds roughly to the more detailed criticism later in the chapter at 214b28-216a26). And this latter explanation involves conceiving of the void as a separate place into which movement takes place (214b20-22). He then goes on to consider the basic question of the void by itself, apart from the question of motion, void as a separate and empty place (214b23-28--which corresponds to 216a26-b21).⁶⁴

Let us then consider first what Aristotle has to say about void as an explanation for motion in his 'general overview' at the beginning of this chapter (214b12-28). Aristotle in effect asks here in what sense void can be an explanation of motion. He considers various alternatives and finds each of them inadequate. The first alternative which he suggests is that the void is to explain the natural motion of the elements, the type of locomotion which is most important to Aristotle. It is quite likely that Democritus admitted some such move-

⁶⁴I will be concerned here with the question of an explanation of motion as presented in Physics 4.8 and in parallel passages, and will postpone the question of void in itself.

ments and attempted an explanation of them either in terms of mechanical pressure or of an 'upward surge'.⁶⁵ It is on this point that Aristotle feels that Democritus is particularly vulnerable; the question of natural motion becomes quite critical in the more detailed refutation to be taken up later (215a1-24). Here Aristotle feels that it is quite sufficient to say that an external void offers no more an explanation of such natural motion (δῆλον ὅτι οὐκ ἂν τὸ κενὸν αἴτιον εἴη τῆς φορᾶς--214b15-16) than did the internal void (On the Heavens 4.2).

Well, if void, Aristotle says, cannot explain natural motion, what does it explain (τίνος οὖν αἴτιον ἔσται τὸ κενόν; --Physics 4.8, 214b16)? It seems most reasonable to assume that the question is general in nature and is not asking about void being an explanation of a particular direction or kind of motion. Aristotle continues after this question: "For it seems to be an explanation of locomotion, but it does not even explain this" (214b16-17). His point seems to be that void was posited simply to account for locomotion, as a necessary condition of it; but, since it does not account for this, there is nothing left for which it can account, and hence no reason to assume its existence.

W. D. Ross in his commentary on the passage seems to assume two things in regard to this passage which tend to weaken

⁶⁵For an explanation of upward movement by pressure, see On the Heavens 4.2, 310a10, and On Breathing 4, 471b24ff.; for the 'surge' see On the Heavens 4.6, 313a14ff.

Aristotle's argument. First of all, he seems to assume that $\tau\acute{\iota}\nu\omicron\varsigma$ (214b16) refers to a specific kind or direction of movement, for in his 'analysis' of this passage he summarizes: "What then can be the locomotion of which it is thought to be the cause?"⁶⁶ Furthermore, he supposes that there is evidently an ambiguity of the word $\alpha\acute{\iota}\tau\iota\omicron\nu$ at stake, for, he says, the supporters of the void posit it as an $\alpha\acute{\iota}\tau\iota\omicron\nu$ in the sense of 'necessary condition', but Aristotle says that void cannot be an $\alpha\acute{\iota}\tau\iota\omicron\nu$ in the sense of 'determining cause' of locomotion in any particular direction. This, he contends, makes Aristotle's argument here worthless.⁶⁷ But neither of these assumptions are necessary or warranted.

As to Ross' first assumption, it has just been pointed out that it is not necessary to take $\tau\acute{\iota}\nu\omicron\varsigma$ as referring to some particular direction or kind of motion. Ross apparently would have Aristotle say: external void does not determine (cause) the direction of locomotion of a body (214b17), and furthermore ($\epsilon\tau\iota$) void does not determine the direction of locomotion of a body placed in it (214b17-24); all this in spite of the fact that Ross himself lists these two as separate arguments (p. 380). But Aristotle's point is evidently that void was supposed to be a necessary condition of locomotion. But it is not, and Aristotle had just shown that it is not in the previ-

⁶⁶Ross, Physics, p. 380.

⁶⁷Ibid., pp. 587-588; Cherniss' reference to the passage, op. cit., p. 151, offers no comment or explanation of the refutation.

vious chapter.⁶⁸ And he had done this by showing that locomotion can be explained by a mutual interchange of bodies, and he had supported this by empirical evidence for such locomotion. And this holds for any void.

Now, as to the ambiguities of the word αἴτιον, Aristotle was quite evidently aware of the ambiguities of that word and is hardly likely to have traded on it, to have gone from one meaning of the word to another, simply for the sake of an argument. If anything, the void for Aristotle was a 'material cause' (see Metaphysics 1.4, 985b9-10, where the void along with the full is described as αἴτια . . . ὡς ὕλην) and not as any sort of an efficient cause, if this is what Ross means--as he seems to--by "determining cause."⁶⁹ But the whole assumption of an ambiguity seems unwarranted; the passage, as has been shown, makes perfectly good sense without it. Aristotle is quite justified in saying that, although the void seemed

⁶⁸Physics 4.7, 214a28ff.

⁶⁹I see no difficulty if the 'determining cause' is to be explained in terms like 'the grain of the wood "determines" the structure of the wood-carving' or 'the density of the medium "determines" the speed of an object passing through it', for, as Aristotle points out, void is undifferentiated and cannot thus affect the direction or speed of movement of an object. Although the void was not intended to give this sort of an explanation of motion, it is certainly not inappropriate or "worthless" to mention this point, for, as we shall see, along with the other parts of the refutation, it will tend to show that there is no sense in which the void is an explanation of motion. But this matter of the void explaining the direction of motion is evidently not the point which Aristotle is making here; he rather begins to make it in the following argument (214b17ff.), as had just been pointed out in the discussion of Ross' first assumption. This interpretation seems more consistent with what Aristotle says in the whole passage.

only to be a necessary condition of locomotion, it is in fact not--and that leaves nothing for the void to explain.

Having now established that the void cannot explain natural motion and that it is not a necessary condition for motion at all, Aristotle goes on with a new point in his refutation ("ετι--214b17): void, conceived of as simply being an empty place (οἶον τόπος ἐστερημένος σώματος --214b18), contributes nothing at all to an explanation⁷⁰ of the direction of locomotion. Aristotle asks, "Where will the body that was set into it (the void) move? (ποῦ οἰσθήσεται τὸ εἰσθεθὲν εἰς αὐτὸ σῶμα--214b18-19), for void is undifferentiated and the object placed in it cannot move into all directions. This is, in effect, to reduce the void to a separate place into which an object can move (τὸν τόπον . . . τι κεχωρισμένον, εἰς ὃ φέρεται--214b20-21), a place for an object--any object of any kind--and nothing more than that.

Thus far, apart from the objection raised by Aristotle to the effect that the void is not a necessary condition of

⁷⁰Cherniss, op. cit., p. 151, without further explanation, reduces the argument at 214b17-24 to "but motion requires absolute differentiation of direction which is impossible in a void and inexplicable on the theory of separate position."

But Aristotle's point here does not seem to be that the void displays no differentiation of direction; it is the limitless void which entails a denial of any such absolute direction like 'up' or 'down', i.e., toward or away from some specific boundary. Aristotle does not here bring up the notion of the limitlessness of the void. His point is rather that the void, as that which is absolutely nothing, cannot contribute anything to an explanation of the direction or speed of locomotion--as a differentiated medium (like air or wood) might help explain the motion of an object in it.

locomotion, many of the other refutations may seem to be pointless, or, as Ross puts it, "not convincing."⁷¹ Indeed, taken as separate 'refutations', they may be or border on being pointless or unconvincing. But we may need to remind ourselves that these separate points are not in fact to be taken as though they had nothing to do with one another; they are part of the fabric of one larger and whole refutation. And this 'whole refutation' culminates (as does the brief overview given by Aristotle at 214b12-28) in a consideration of the void as nothing but a place for a body and in a questioning of the validity of positing such a void or empty place as existing separately. But, before proceeding to that point, there is still more to be said in detail about the void as an explanation of motion. And that more detailed account occupies the greater bulk of the central portion of this chapter on the void in the Physics (4.8, 214b28-216a26).

And in this more detailed account at 214b28-215a1 Aristotle repeats substantially the same point that he had made earlier in his refutation at 214b17-22. Void, inasmuch as it is void, is materially undifferentiated ($\tilde{\eta}$ γὰρ κενόν, οὐκ ἔχει διαφοράν--214b33-215a1) and hence cannot in principle contribute anything at all to our understanding of why things should have a tendency to move in one direction rather than another. But, if the void cannot explain that, then it does

⁷¹Ross, Physics, p. 587.

not help us to understand as well why they should move at all.⁷² Thus, if one is to explain at all the variety of motions that evidently take place, that explanation must lie somewhere other than in the void itself. And in this sense the void is completely otiose.

At 214a13 Aristotle had pointed out in a preliminary way that the void could not account for the natural motion of the elements, namely, the movement of fire upward and that of earth downward toward the center of the universe. Now at 215a1-13 he takes up this position afresh and attempts to show more specifically how this fact of natural motion and the supposition of a void are incompatible. Aristotle introduces here an important distinction between natural and forced (which is one kind of unnatural motion) motions (215a1-6). But the

⁷²Aristotle says at 214b30-31: μή ἐνδεχέσθαι μηδὲ ἐν κινεῖσθαι, ἐὰν ᾗ κενόν. This Cherniss, *op. cit.*, p. 151, takes to mean that motion is impossible (as contrasted to 'inexplicable') in a void. Ross' position is not as clear; in his 'analysis' or summary of the content of this passage he writes: "Instead of void being necessary if there is to be movement, it is incompatible with movement." (p. 380) This is milder than his statement in the 'commentary' section (p. 588): "The first reason why a void makes movement impossible was given in 214b31-215a1." Likely the latter statement is to be interpreted in the light of the former, that is, to take 'impossible' in the sense of 'unintelligible' (see *Metaphysics* 5.12, 1019b32-33 and Ross' comments on ἐνδεχόμενον as 'logically possible' in his *Metaphysics* I, 322. What Aristotle does indeed show is not that motion is impossible in a void, but that it is impossible to explain; it is unintelligible.

And what Aristotle points out here is that the atomists assume that the void is a necessary condition of locomotion; but, he further says, even if one does assume the existence of the void, one can argue as validly--and, indeed, with more cogency (μᾶλλον--214b30)--that in a void all things must be and remain at rest. The positing of a void not only does not help explain motion, but it impedes that explanation as well.

void, he shows, makes such a distinction impossible in principle, particularly so if that void is boundless; for, inasmuch as the void is boundless, there is no point of reference from which we could say that any place was up or down or in the middle. And, inasmuch as it is truly void and undifferentiated, there is no difference between up and down in it (215a6-11). But natural motion, Aristotle points out, has such differentiation (ἡ δὲ φύσει πορὰ διάφορος --215a11-12). Thus the concepts of void and of natural motion are mutually exclusive; and it is for this reason that the positing of void denies the fact of natural motion and thus any real distinction between natural and forced motion.

But it is precisely this sort of a distinction which one needs in order to explain the action under the influence of 'forced motion'-- κίνησις βίη or παρὰ φύσιν--(215a14-24). Aristotle takes the obvious example of 'forced motion'--a thrown object. The movement of that object when the force is exerted against its natural motion is evidently the excess of the exerted force over the natural motion.⁷³ The 'forced motion' of such an object diminishes until it ceases altogether.⁷⁴ But this sort of motion cannot take place in the void; it requires a positive medium, both to give some account of the mechanics (ἡ δὲ ἀντιπερίστασις . . . ἡ διὰ τὸ ὥθειν τὸν ὥσθέντα ἄερα

⁷³See also On the Heavens 3.2, 301b18. The 'force', when it works in the same direction as the natural motion, accelerates the motion (θάττω ποιήσσει--301b22).

⁷⁴See Physics 8.10, 266b27-267a12.

οὐκ ἔστι κίνησις--215a15-16, if these are actually two⁷⁵ alternatives) of such motion and to explain why the object should stop at one place rather than another; it would in the void simply continue moving on indefinitely (215a19-22).

The object may indeed stop in a void if something more powerful gets in its way, and, in that case, it (either will stay stopped and unsupported in the void, which is impossible if it has weight, or) must start off anew in a different direction. It will obviously move into the void because the void is that which will give way. But now there is no explanation of the new direction of its motion; it might just as well move in all directions in an undifferentiated void. This (215a22-24) is still part of the refutation of an attempt to account for the two evident kinds of motion which present themselves in connection with a thrown object.⁷⁶ Thus the void not only fails to explain the gradually diminishing motion and eventual stopping of the thrown object, it fails as well to explain the 'new' motion that occurs after the object has temporarily stopped.

⁷⁵Ross, Physics, p. 589.

⁷⁶Ross, Physics, p. 589, suggests that Aristotle is arguing as follows: the atomists say that objects move through air faster than they do through water because there is more void in the air; but void is undifferentiated, and so the objects would move in all directions. Ross then labels Aristotle's argument as unconvincing. But Aristotle has been talking about an object for some reason coming to a halt; and now he adds that, once stopped, if the object is to move again, it must move in all directions precisely because the void is undifferentiated.

The previous part of this refutation of the existence of a separate void to account for motion (215a1-24) was formulated in terms that show void incompatible with the notion of natural motion and with any distinction between natural and forced motion. In this next part of the refutation (215a24-216a26) Aristotle considers what the concept of the void can contribute to an explanation of motion quite apart from a direct consideration of natural motion. There are, Aristotle says, two factors which contribute to an explanation of the motion of objects (διὰ δύο αἰτίας --215a26): the first is a variation in the medium in which motion occurs (τῷ διαφέρειν τὸ δι' οὗ --215a26, which is considered more fully at 215a24-216a11); the second is a variation in the moving object itself (τῷ διαφέρειν τὸ φερόμενον --215a27, which is taken up again at 216a11-20). Both of these factors are matters derived from empirical evidence.⁷⁷ And Aristotle will show that the theory of the void is incompatible with each of these factors.

Aristotle takes up first the matter of the medium as a factor in the explanation of the movement of an object (τὸ μὲν οὖν δι' οὗ φέρεται αἴτιον --literally: "that through which (an object) moves is an explanatory factor", 215a29), that is, an explanation of its speed. His discussion is lengthy and detailed, but there seems to be substantial agreement on what he says here. For Aristotle all the evidence that he had avail-

⁷⁷One notes in particular the prominence of the word φερόμενον at the beginning of each of the two sections, at 215a25 and at 216a13.

able to him points to the fact that there is an inverse relationship between the speed of the moving object and the density of the medium in which it is moving. Considering the evidence available to him, his conclusion is certainly reasonable.⁷⁸ He further shows that there is in principle no proportion between void and some specific density. Thus speed in pure void would exceed all proportion, and hence all calculation ($\pi\alpha\nu\tau\omicron\varsigma \ \upsilon\pi\epsilon\rho\beta\acute{\alpha}\lambda\lambda\epsilon\iota \ \lambda\acute{o}\gamma\omicron\upsilon$ --215b22), and the time taken to move through some fixed distance of void will be small beyond measure. There is thus no way in which one can give a rational and understandable account of movement in a void. So, when we consider the medium as a factor in the explanation of the motion of an object, the theory of the void will abolish any idea of proportion between density and speed and time, and so will not only fail utterly to make motion understandable, but will also contradict empirical evidence.

The second factor in an explanation of the movement (that is, in the rate of speed) of an object is its bulk; and

⁷⁸Stephen Toulmin, "Ideals of Natural Order" in Philosophical Problems of Natural Science, ed. by Dudley Shapere (New York: Macmillan Company, 1965), pp. 112-117, points out rightly that Aristotle was not attempting to arrive at a theory of 'velocity' in the modern sense; and so it would be unfair to criticize his attempts in terms of modern science and modern concepts; Aristotle, he says, may also have been right about the void, for we can either create or find (in outer space) conditions which only approximate void.

Cherniss, op. cit., p. 152, is concerned to find fault with Aristotle precisely because he did not arrive at a modern theory of velocity: "the real error in this argument is the assumption that velocity varies inversely with the density of the medium."

this factor is now considered in relation to the void at 216a11-20. Again there is empirical evidence which seems to warrant positing a fixed relationship between the size and the speed of objects composed of the same substance (ἐὰν τᾶλλα ὁμοίως ἔχῃ--216a14). If there is to be any coherent and understandable motion in the void, this same relationship ought to hold there too. But it does not and it can not, for objects ought all, regardless of size, move at the same speed in void. But such a supposition flies in the face of all the evidence available.⁷⁹

Finally, at 216a20-26 Aristotle summarizes this attempt to account for motion by positing the void by indicating that the concept of the void is totally incompatible with the two factors which all the evidence shows contribute to an explanation of motion. In the light of both these factors the void fails to account for motion in any way; it only serves to make motion unintelligible. Democritus' void was meant, Aristotle says, to account for sense experience, one of the items of which is motion. But it cannot account for it, for the suppo-

⁷⁹Ross, *Physics*, p. 591, says that what Aristotle thought absurd is now known to be a fact. But we must remember that this does not affect the validity of Aristotle's argument (on the basis of the evidence he had), but only the correctness of his conclusion. Ross also mentions here Cornford's statement that Epicurus divined this fact without experiment. But this is unlikely, for Epicurus probably got it from Aristotle (as he did some other variations on Democritus' atomism). One might compare Aristotle's use in this present passage of ἰσοταχῇ (216a20), which Epicurus apparently merely changed to the appropriate feminine form ἰσοταχεῖς when he proposed this doctrine in *Epistle* 1.61 (ed. Usener).

sition of a void contradicts sense-experience, contradicts all that we can see and know about the motion of physical objects.

In the light of this failure to explain motion, the positing of a separate void can amount to nothing more than the positing of a separate place, which does nothing at all to account for motion. And this is the aspect of the void which Aristotle discusses next in this chapter (216a26-b21). But, before going on to this, there are two further passages in On the Heavens which deal with the question of motion.

The two passages in question do not deal directly with the problem of the void, but, inasmuch as the theory of the void has been shown to make impossible any account of natural motion, they do present further difficulties, as Aristotle points out, in explaining in terms of atomism motions which are seen to be natural.

In the first of these passages--On the Heavens 3.2, especially 300b9-301b30--Aristotle presents a general refutation of a position which will not adequately account for natural motion. He begins by showing that we have empirical evidence for natural rest.⁸⁰ But this, he says, implies a natural motion to that place of rest. And this is why Democritus ought to have specified what sort of motion--natural or unnatural--the atoms have (διὸ καὶ Λευκίππῳ καὶ Δημοκρίτῳ, τοῖς λέγουσιν ἀεὶ κινεῖσθαι τὰ πρῶτα σώματα ἐν τῷ κενῷ καὶ τῷ ἀπείρῳ, λεκτέον τίνα κίνησιν καὶ τίς ἡ κατὰ φύσιν αὐτῶν κίνησις --300b9-

⁸⁰300a30: φαίνεται τι μένον ἐπὶ τοῦ μέσου.

11) and what is their natural motion.⁸¹ But Democritus had said that his atoms are in everlasting motion (ἀεὶ κινεῖσθαι--300b10) and so made a prior natural motion impossible, for there is for him only an endless series of forced motions; and, since one cannot exhaust the series of forced motions, one can never arrive at a natural motion: ἀεὶ τὸ πρότερον βίq κινούμενον κινήσει--"the earlier atom will always set the next in motion qua itself being in forced motion"--300b16.⁸² And so again the void and eternally actual motion in it involve a denial of any real natural motion, and hence a denial of our empirical evidence.

But even more than this, there is a further sense in which this sort of motion denies sense-perception (300b32-301a11), for there are as many different motions, Aristotle says, as there are movers; and this number in atomic theory would be boundless: εἰ δ' ἄπειρα τὰ κινούντα καὶ τὰς φορὰς ἀναγκαῖον ἀπείρους εἶναι--301a1. And this boundless number is disorderly, for order and system require some limitation. But we perceive order in natural objects and the order that we perceive there is natural.⁸³ But Democritus, Aristotle says,

⁸¹See also Metaphysics 1.4, 985b4ff. and 12.6, 1071b32ff.

⁸²Simplicius' explanation, de Caelo, pp. 583-584, is substantially the same: the infinite regress that this generates makes it impossible that any atom can conceivably be (originally) set into this 'forced' motion (οὐδὲν κινηθήσεται).

⁸³301a6-7: ἡ γὰρ τάξις ἡ οἰκεία τῶν αἰσθητῶν φύσις ἐστίν--"for that order which belongs properly to what is perceived is their nature." τῶν αἰσθητῶν, is evidently important here.

claims in effect that the disorderly movement of the atoms is natural, and the order that we see is unnatural: τὴν μὲν ἀταξίαν εἶναι κατὰ φύσιν, τὴν δὲ τάξιν . . . παρὰ φύσιν--

301a10-11. Thus atomism not only denies the validity of some items of sense-perception, but also the order that we perceive in nature.⁸⁴

The second passage, which shows another difficulty with Democritus' account of what Aristotle would call 'natural motion', is to be found at On the Heavens 4.6, 313a14ff. There Aristotle attributes to Democritus what Democritus himself had evidently called a 'surge' (σοῦς),⁸⁵ which Aristotle here seems to identify with upward-moving warm elements (τὰ ἄνω φερόμενα θερμά--313a24).⁸⁶ With this 'surge', as Aristotle reports it, Democritus had attempted to account for the floating of heavy, flat objects on water. But this 'surge', Aristotle points out, ought--as Democritus himself recognized (ὥσπερ ἐνίσταται κάκεινος αὐτός--313b4)--to occur to a higher degree in the air, for, since all kinds of atoms are in all elements,⁸⁷ air ought to contain more of such 'warm' elements

⁸⁴Cherniss, op. cit., p. 194, claims that these difficulties "depend for their validity upon Aristotelian concepts of 'natural' and 'unnatural' motion." But they rather depend on empirical evidence for such a distinction between 'natural' and 'unnatural' motion.

⁸⁵See Kurt von Fritz, op. cit., p. 29.

⁸⁶See also 313b5: λέγων σοῦν τὴν κίνησιν τῶν ἄνω φερόμενων σωματίων.

⁸⁷See the use of πανοπερμία; also Simplicius, de Caelo, p. 730, line 10: εἶναι γὰρ πάντων σπέρματα ἐν πᾶσι.

than water. But Democritus' reason for claiming that the 'surge' does not cause heavy objects to float on air is that in the air the 'surge' is more scattered.⁸⁸ But this explanation, Aristotle says, is weak (λύει μαλακῶς--313b3) evidently because there are more spherical atoms in air (for breathing) than in water. Aristotle then goes on to show that there is a better and more consistent explanation if one does not suppose that void is a factor. Both the body in motion and the medium into which the body is placed are continuous; they have no void in them. The heavy body has a natural motion downward, but its natural downward motion is resisted by the continuity of the medium (water, for example). And when the resistance of the medium is greater--because of the flatness of the heavy body--the body will float (313b5-22).

Thus Aristotle has shown that Democritus' attempts to explain motion in terms of void were abortive; they did not survive closer scrutiny, for either the explanation was weak and there was a demonstrably better and more consistent one, or it made motion unintelligible, or it contradicted empirical evidence. The objections raised by Aristotle against the void

⁸⁸Both Guthrie, *On the Heavens*, p. 369, ("the surge does not work in one direction only") and Cherniss, *op. cit.*, p. 203, note 231, ("does not take place in a single direction") seem to be adding the idea of different directions of the 'surge', whereas the 'surge' was supposed to be a specifically upward movement. But οὐκ εἰς ἓν ὁρμαίν τὸν σοῦν seems only to mean that the concentration of atoms in the 'surge' is less unified; the atoms are more scattered. See also Simplicius, *de Caelo*, *ad loc.*, p. 730, lines 21-22: διεσπαρμένων οὖν αὐτῶν οὐκ εἰς ἓν ὁρμαῖ ἡ κίνησις αὐτῶν.

as any sort of an explanation of motion are cumulative and convincing. We are now ready to abandon as untenable any use of the void to account for motion and pass on to considering the void as simple, separate place; that is, we are ready now to take up again and continue the refutation of Aristotle where we had left it at Physics 4.8, 216a26.

Separate Void by Itself

Throughout his whole detailed discussion of the void in Physics 4.6-9 Aristotle had been repeatedly concerned with the question of the simple, separate existence of the void, quite apart from its role in explaining motion or anything else. On each such occasion the matter of a refutation had been taken up quite summarily, if at all. The more full refutation is left for discussion primarily in Physics 4.8. The following then will briefly survey such preliminary remarks by Aristotle before taking up his fuller discussion of the question.

Immediately at the beginning (Physics 4.6) of the excursus on the void Aristotle points out that those who posit the void confuse it with 'place' (τόπον τινὰ . . . τὸ κενὸν τιθεῖσιν--213a16), which, when it has no body in it, is simply empty (ὅταν δὲ στερηθῇ, κενόν--213a18). And Aristotle's preliminary reply here is simply that 'void' and place refer to essentially different things: τὸ δ' εἶναι αὐτοῖς οὐ τὰυτὸ ὄν ("they have an essence which is not the same")--213a19.⁸⁹

⁸⁹This is taken up at Physics 4.8, 214b23-28.

The matter is again brought up at Physics 4.7, 213b31 (δοκεῖ δὲ τὸ κενὸν τόπος εἶναι ἐν ᾧ μηδὲν ἐστὶ), for void seems to be a place in which there is nothing, that is, no body. In order to substantiate this apparent identity of 'void' with 'place' Aristotle then goes on (213b30-214a22) to show that void for the atomists fits quite well with that which he himself thinks of as place, only deprived of a body. Void, Aristotle says, is certainly not tangible (ἀπτόν),⁹⁰ and thus would not have any kind of weight in one direction or another (ἐν ᾧ μηδὲν ἐστὶ βαρὺ ἢ κοῦφον --214a2-3). The only attribute that can possibly be ascribed to it is that of extension (διδόστημα--214a5-6),⁹¹ otherwise it would have a definition which would also fit a mathematical point, which would be absurd: ἄτοπον εἰ ἡ στιγμὴ κενόν --214a4-5. Thus Aristotle feels that he has now established as a logical fact (ἀνάγκη--214a16) what earlier had only seemed (δοκεῖ--213b31) to be the case: void, if it exists at all, is place deprived of body.

⁹⁰This is taken up at 4.8, 216b13-20; though most of this passage has been bracketed by both Bonitz and Ross because of its doubtful support from the Greek commentators, I propose to consider it, since it does have universal manuscript attestation. But how it could have (as noted in the first Basel edition) come from Averroes (who lived in the twelfth century) when the earliest manuscripts (E and J) date back to the tenth century, is beyond me.

⁹¹Aristotle (214a9-10) half in jest, I believe, asks whether the void as such extension could contain something non-tangible and yet perceptible. There is no doubt in Aristotle's mind that for Democritus all perceptible qualities are tangible: Δημόκριτος δὲ καὶ . . . πάντα γὰρ τὰ αἰσθητὰ ἀπὸ ποιοῦσιν (On Sensation 4, 442a31-442b2). This is an essential and consistent part of Democritus' theory.

This brings us back to the preliminary remarks of Aristotle at Physics 4.8 (specifically, 214b23-28). There, in the process of his refutation of the existence of a separate void, he brings in an argument to show that 'place' and 'void' must have meanings which are quite distinct. The subject of the argument is a continuous⁹² physical object in a separately existing place. Although, as such, this argument or refutation does not apply directly to the physical objects of the atomists, because for them physical objects are not whole and continuous (any atomic part of a physical object for them can at best be in contact and hence will not be continuous with other parts), still it applies to their atoms themselves, for these are what are for them precisely whole and continuous. The argument goes like this: any conceivable part of any whole object (or atom) must simply and only be in that object; its place there is coextensive only with the room it takes up in that object; its place there is not the room it takes up plus some surrounding area. The part is not inside of some surrounding area which is its place; it is thus not in a separate place. If 'place' and 'void' are synonymous, if the statement 'a part is in its place' means 'a part is within a separate void', then--to apply the refutation specifically to an atom--any conceivable part of an atom, since that part must

⁹²Compare Simplicius, In Physicorum, ad loc., pp. 665, line 36 to 666, line 1: τὰ δὲ μέρη αὐτοῦ τὰ συνεχῆ. It is important that the parts of the object be continuous, for, if each part were in a separate place (i.e., in a separate void), then the object could not be a continuous whole.

also be in its place, must also be separate, for it too must then be in a separate place. Thus not even the atom itself would be exempt from further analysis into an infinite number of sub-atoms.⁹³ Thus the outcome of Aristotle's argument is that, if unity is to be retained anywhere at all, at any level, whether in physical objects or in atoms, then 'place' and 'void' must be kept distinct. This argument alone does not prove that there is no separately existing continuous extension,⁹⁴ but only that 'place' and 'void' must refer to essentially different things.

The detailed argument against the void as a separately existing place is to be found at Physics 4.8, 216a26-b21. It seems to be presented in two parts.⁹⁵ In the first the void is conceived of as occupied by a body; and when it is so considered the void is indistinguishable from the volume of that body; it amounts simply to the bulk of that body, the body's volume abstracted from all the other attributes of the body.

⁹³I suspect that it is from this argument, among others, that some later atomists or commentators felt that the atoms cannot have parts.

⁹⁴Cherniss, op. cit., p. 149 (especially note 28), objects that this is not a cogent argument against separately existing continuous extension and that it further compounds the difficulty by involving the problems of the whole and its parts. But I maintain that this particular argument was not by itself meant to disprove any separately existing continuous extension, but only to show that there is a real distinction between 'place' and 'void'. And it is precisely the concepts of 'whole' and 'parts' that make this distinction clear.

⁹⁵The second part I take to be the passage at 216b17-20 referred to above (note 90), which has good manuscript evidence but is not cited by the early Greek commentators.

Aristotle illustrates this by the example of a cube placed into the hypothetical void; the cube would actually displace nothing (though it would displace some water or air, if it were placed in one of them) and the formerly empty void would then penetrate the entire volume of the body; the size of the cube would be exactly the same as the size of the formerly empty void. Thus we would now have two different things--void and volume--in the same place, or, more likely, these two things are the same, and void in this case is nothing more than the volume of a body. The void that the cube now occupies is indistinguishable from its volume. Furthermore, the cube continues to have that same size, bulk, volume, or place, no matter where it goes. For this reason it is more likely that we have throughout been talking about an attribute which belongs to a body rather than about something separate and distinct from that body. Thus, when void is occupied, there is no reason for assuming that it is something distinct from the body occupying it; it amounts to nothing more than an attribute of that body abstracted from it, and so has only mental status.

Secondly (216b17-20), when this hypothetical void is not occupied by a body, we have in principle no evidence for it at all. The only evidence that we can have is, on the principles of atomism themselves, that of touch, and that gives us evidence only of that which is touchable ($\tau\eta\ \delta\phi\eta\ \gamma\alpha\rho\ \eta\ \kappa\rho\acute{\iota}\sigma\iota\varsigma\ \tau\omicron\upsilon\ \delta\pi\tau\omicron\upsilon$ --216b19-20); and void is by definition not touchable.

Thus Aristotle has shown that whether it is filled or

not, there is in neither case any evidence for the void. So, as far as evidence goes, it is clear that there is no separate void: ὅτι μὲν τοίνυν οὐκ ἔστι κεχωρισμένον κενόν, ἐκ τούτων ἔστι δῆλον --216b20-21.

But, if all this is reasonably accurate, if void is not necessary to an explanation of motion, if using the void in one's attempt to explain motion contradicts evidence and principles derived from evidence, if there is indeed no evidence for the void, then perhaps there is some other justification for supposing that the void exists. And in refuting the position of Democritus Aristotle also considers this 'other justification' for positing an existing void; this he does in two places, the one in the Physics (1.3, 187a1-11), and the other in the Metaphysics (4.5, 1009a22-38).

On two separate occasions (though in the same works just mentioned) Aristotle attributes specifically to Democritus a teaching that the void exists as 'that which is not': Δημόκριτος . . . κενόν . . . ὡς οὐκ ὄν εἶναι φησιν (Physics 1.4, 188a22-23), and Δημόκριτος . . . τὸ κενόν εἶναι φασί, . . . τὸ δὲ μὴ ὄν (Metaphysics 1.4, 985b5-6). But in neither of these passages is there a refutation of the existence of the void as 'that which is not'; this refutation is taken up instead in the two passages just mentioned prior to these latter passages (namely, at Physics 1.3, 187a1-11 and at Metaphysics 4.5, 1009a22-38); and both of these passages undoubtedly refer to

precisely this doctrine of Democritus.⁹⁶

Atomism, or, to be more specific, the teaching that there is a void, was formulated with a two-fold consideration in mind, a consideration engendered by Eleatic arguments:⁹⁷ it was an attempt account for motion (the refutation of this aspect has just been considered), and it was an attempt to respond to Eleatic arguments on 'what is'. And it is now from this latter point of view that Aristotle criticizes those who assume that the void exists as 'that which is not'.

The atomists,⁹⁸ Aristotle says at Physics 1.3, were influenced by ('gave in to', 'made some concessions to'--ἐνέδοσαν--187a1) to one particular Eleatic argument⁹⁹ on the meaning of 'what is' (τὸ ὄν). The Eleatic argument is the following: 'what is' has one meaning (ἐν σημαίνει --187a4),¹⁰⁰ namely, 'what simply exists', and cannot at the same time refer to the contradictory of this, that is, 'what is not'.¹⁰¹ But on the

⁹⁶Democritus is mentioned specifically in the Metaphysics passage; no one is named in the Physics passage, but Ross', op. cit., pp. 480-481, given in his commentary on this passage, are quite cogent and have been most recently accepted by Charlton, op. cit., p. 63.

⁹⁷See On Generation and Corruption 1.8, 325a1-32.

⁹⁸See note 96, above.

⁹⁹This argument had just previously been ascribed by Aristotle (186a24-25) to Parmenides. The whole argument is separated in this passage into two parts (187a1-2 and 4-5); I have put them together for the sake of convenience.

¹⁰⁰See also 186a24-25: ἀπλῶς λαμβάνει [Παρμενίδης] τὸ ὄν λέγεσθαι.

¹⁰¹Charlton, op. cit., p. 7: "can both be and not be."

phenomenal level, the Eleatics would claim, such contradictory statements are possible; for example, at one time one can truly say 'this apple is green', while on a later occasion one can, evidently referring to the same apple, say the contradictory, 'this apple is not green' (when it has turned red). Since contradictories cannot in reality be true, 'what really is' is one and undifferentiated and refers to something only in the simple and absolute sense of 'is'. Furthermore, 'what is not'--as the contradictory to 'what is'--cannot therefore exist; all that there is is simply and absolutely 'what is'.

This then is the argument to which the atomists made some concessions, in that the 'what is' of the atomists is evidently formulated in terms of the Eleatic 'what is', as is now more generally admitted.¹⁰² 'What is' in the atomist sense is something quite distinct, as we have seen, from physical objects; it is, like the Eleatic 'what is', simple and absolute. But for the atomists 'what is' (an atom), while it cannot be seen or, perhaps, felt in isolation, it can affect us physically and thus indirectly can be known.

The Eleatics had further argued that if 'what is not' (that is, the void) does not exist, then motion is impossible. Here the atomists were more influenced by the empirical evidence for motion than by dialectic;¹⁰³ they contended that, if there is motion (which is evidently the case), then 'what is

¹⁰²See Guthrie, History, II, 389-392.

¹⁰³Compare Gen. et Corr. 1.2, 316b10-14; 1.8, 325a25-28.

not' must indeed exist just as much as 'what is'. And the atomist 'what is not' is likewise used in a simple and absolute sense of 'is not'. The atomists had under Eleatic influence argued from a simple and absolute sense of 'is' (and from empirical evidence for motion) to the existence of 'what is not': εἰ τὸ ὄν ἐν σημαίνει, ὅτι ἔστι τὸ μὴ ὄν --187a1-2.

But in the first place Aristotle points out in refutation of the atomists that they were misled by the Eleatic argument, because, as he had been showing throughout the chapter (1.3), the premise is not true, that 'what is' has only the one meaning of 'simple existence'. Hence the atomists are totally unjustified in drawing from such a premise the conclusion that 'what is not' (that is, the void) exists.

And furthermore, Aristotle goes on to point out that their conclusion is evidently false too (187a5-6), for 'what is not' may in any case simply refer to what is not some specific thing (μὴ ὄν τι); it does not even follow from the fact that 'what is' has only this absolute sense that 'what is not' has it too.

Aristotle presents a similar criticism of the existence of the void as 'what is not'--again, along with such a criticism of the existence of 'what is' as he had in Physics 1.3--at Metaphysics 4.5, 1009a22-38. The subject under discussion here is the various attempts to account for the contraries and contradictories which appear to be true of the same physical object. Then what is likely to represent Democritus' train of

thought in considering this question is presented at 1009a25-30; and, as we follow that train of thought as presented here, let us consider at the same time an example as a case in point, a given identical apple in which we see contraries arise (ὁρῶσιν ἐκ ταύτου γινόμενα τάναντία --1009a24-25); it is now green, and then it turns red. Now there is a red apple where there was none before. But 'what is not' cannot come into being (μὴ ἐνδέχεται γίνεσθαι τὸ μὴ ὄν --1009a25-26), and evidently the atomists would take this 'what is not'--as in Physics 1.3--in only an absolute sense. Furthermore, the atomists would go on to say, since such contraries are seen in the phenomenal world, there must be another level at which the 'law of contradiction' holds, a non-empirical level which is accessible to the intellect. This latter level is the real level of atoms and void. Thus the full and the void, that is, 'what is' and 'what is not', are to be found at any given section (καθ' ὅτι οὖν . . . μέρος --1009a28-29) of the phenomenal object; and these atoms and void can help to account for the occurrence of phenomenal contraries without themselves being in violation of the law of contradiction.

Now Aristotle at 1009a30ff. begins his criticism of this view which led Democritus to suppose the existence of the void as 'what is not'. He first admits that in a sense they are right (τρόπον μὲν τινα ὁρθῶς λέγουσι --1009a31), evidently in the sense that 'what is not'--in the absolute sense of the word, 'what does not exist'--cannot come into being. But, in

another sense they are wrong (ἀγνοοῦσιν--1009a31), inasmuch as both 'what is' and 'what is not' are used in two senses (λέγεται εἰχῶς--1009a32)¹⁰⁴ and are not restricted to the single meaning which they give them. There is a sense in which something can come into being from 'what is not' (ἐνδέχεται γίγνεσθαι τι ἐκ τοῦ μὴ ὄντος--1009a33), that is, when 'what is not' is used in the qualified sense: a red apple can come into being out of 'what is not' a red apple, but a green one. Thus the refutation here in the Metaphysics, directed more specifically at Democritus, is essentially the same one that had been raised at Physics 1.3.¹⁰⁵

Cherniss raises the objection to this refutation¹⁰⁶ that it is a logical analysis which does not affect the atomist physical theory itself, though some others may have used this physical theory as a foundation for logical nihilism; Aristotle should not have claimed that the physics was false because the logical consequences mistakenly drawn from it by others were untenable. But Cherniss seems to be in error on

¹⁰⁴The summary that Ross, Metaphysics, I, 273, presents makes it seem that the two senses mentioned here are 'potential' and 'actual'; this is misleading at this point, for the distinction between potency and act does not come in until the question arises about the same object being contraries simultaneously.

¹⁰⁵This evidently establishes even more firmly Ross' identification of the ἐνιοι mentioned at Physics 1.3, 187a1 as the atomists, though no one, as far as I know, cites this passage in making that identification (likely because the citation from On Generation and Corruption 1.8, 324b35ff. makes it certain enough).

¹⁰⁶Op. cit., pp. 78-79.

this point. Aristotle's attack is quite to the point and quite valid; the physics of atomism depended in part on the mistaken logical consequences drawn from an observation of the physical world in combination with Eleatic influence; and he is pointing out precisely where those principles of the Eleatics are in error. They are in error inasmuch as they without warrent assume only an absolute and simple meaning for 'what is' and 'what is not' and in the end they force a denial of empirical fact. And, since the physics of the atomists is founded in part on that specific error, their theory rests on weak ground.

Furthermore, Aristotle goes on to point out at 1009a33-38, contradictories can be true of the same thing at the same time: the apple in question may be at the same time both actually green and potentially not green. And this is because of Aristotle's distinction between potency and act. For Democritus 'what is' and 'what is not' were and remained forever actual; and it was this lack of a distinction between potency and act which kept Democritus from retaining the same continuous substance in the midst of change; had he recognized this important distinction, he would have seen that there is no necessity at all for the absolute existence of 'what is not'. And so, beside the fact that the positing of the void as 'what is not' rests on a mistake and so is untenable, it is in addition absolutely unnecessary.

Thus Aristotle's refutation of the existence of the void

is complete; he has shown that both as part of an account of motion and apart from accounting for motion, the void of Democritus is unnecessary, unempirical, and untenable.

CHAPTER III

ON THE STRUCTURE OF PHYSICAL OBJECTS, SOUL, SENSE-PERCEPTION, AND KNOWLEDGE

Introduction

Democritus, in order to solve the difficulties posed by the Eleatic dilemmas, had posited the existence of atoms and void, and he thought that by doing so he had devised a systematic explanation which was completely consonant with the phenomenal world of motion, change, and its variety of objects. But, since the atoms and void were central to that systematic explanation, Aristotle by his criticisms of them--as we have seen in the first two chapters--had struck some telling blows against the very foundations of atomism as it was espoused by Democritus.

The importance of atoms and void to the theories of Democritus is obvious enough, but Aristotle saw a third area of critical importance to atomism, the problem of the relationship of physical objects composed of atoms and void to our perception of those objects, the problem which essentially has come up in connection with the British empiricists, that is, if we perceive only sense-data, in what sense--if any--do we perceive or know the physical object. Democritus thought that his account was consonant with phenomena, but, as Aristotle and

others have shown, it leads to a sceptical position about physical objects in this phenomenal world.

Aristotle quite explicitly says that Democritus took as the starting-point of his account of his theory the phenomenal world of nature just as it is (ἀρχὴν ποιησάμενοι κατὰ φύσιν ἥπερ ἐστίν--Gen. et Corr. 1.8, 325a1-2), that he was convinced by arguments founded on the nature of things (φυσικοῖς λόγοις πεπεισθαι--Gen. et Corr. 1.2, 316a13-14), that he was convinced that his arguments were completely consonant with what we perceive, that is, with generation, corruption, change, and multiplicity (πρὸς τὴν αἴσθησιν ὁμολογούμενα . . . γένεσιν . . . φθορὰν . . . κίνησιν καὶ τὸ πλῆθος τῶν ὄντων --Gen. et Corr. 1.8, 325a23-25).¹

It was this concern with the phenomenal world which Aristotle says led Democritus to posit his atoms and void; his theory proceeded from what he had perceived. Like Anaxagoras, he was puzzled by what he saw; the same physical object seemed to take on at various times contrary qualities; but 'what is not' could not come into being, and so both 'what is' and 'what is not' had already from the first to belong to the physical object in question, but in some sense other than the merely phenomenal one. Democritus' solution was to distinguish the physical from the phenomenal object and to identify

¹Paul Natorp, op. cit., pp. 164-179, denies this; see especially p. 178, "Aristoteles also referirt nicht über Demokrits Lehre, sondern beurtheilt sie, und er beurtheilt sie aus einem falschen Gesichtspunkt, wenn er Demokrit zum Sensualisten macht."

'what is' and 'what is not' respectively with atoms and void which make up the physical object.²

But Aristotle also tells us that Democritus argued from phenomena not only to the existence of atoms and void, but also to the shape of atoms and to their arrangements in objects, for he tells us that Democritus says that it is evident what sort of thing man is structurally, since a man is recognized as such by his shape and coloration;³ and this, as we shall see more clearly later, is likely an argument from appearance to atomic structure. Or again, at Metaphysics 1.4, 985b13 we find that the differing shapes and arrangements of atoms were meant to account for all other objects and their qualities.⁴

Thus, since there is for Democritus a relation between the object as it is perceived and as it really is--that is, atomically structured--we shall be examining in this chapter, first of all, Aristotle's critique of the real structure of physical objects, as that structure is explained in the system of Democritus.

We have indeed already considered briefly some of Aristotle's major objections to Democritus' teaching about the structure of physical objects in connection with both the doc-

²Meta. 4.5, 1009a22-30; ἐλήλυθε . . . ἡ δόξα ἐκ τῶν αἰσθητῶν. . . ὁρᾶσιν ἐκ ταύτου γιγνόμενα τάναντία. . . . καὶ γὰρ οὗτος τὸ κενὸν καὶ τὸ πλήρες ὁμοίως καθ' ὅτι οὖν ὑπάρχειν μέρος, καίτοι τὸ μὲν ὄν τούτων εἶναι τὸ δὲ μὴ ὄν.

³Part. Anim. 1.1, 640b32-34.

⁴τὰς διαφορὰς αἰτίας τῶν ἄλλων εἶναι.

trine of the atoms and that of the void; there we have seen that Democritus, in positing atoms and void, fails to account for--and, indeed, denies--the obvious unity of the object, and that he does not give an adequate account of either the weight or the locomotion of objects. Furthermore, we shall see in the next chapter what Aristotle considers to be another failure in the attempt to give an atomic account of the structure of physical objects, that is, that it fails as well to provide an adequate 'formal cause' for the object.

It hardly does justice at all to the total impact of Aristotle's criticisms to separate them under different headings, if their separation from one another gives the impression that they are to be taken in total isolation from one another. But these are not totally separate criticisms, but varying aspects of a single criticism artificially isolated to give us a better understanding of the criticism as a whole and of its various implications. It is for this reason that I have chosen to err on the side of repetition rather than that of absolute isolation of arguments.

Aristotle's major objection to the atomically structured physical object is basically that such a theory does not do justice to the physical object as it is, that is, as it is perceived, as it is a matter of empirical fact. What we perceive are in fact physical objects with certain qualities.

Next we shall consider briefly the nature of soul for Democritus; since it is atomically structured, it suffers from

some of the same defects that Aristotle sees in other objects which Democritus explains by means of atoms: it is reduced for Aristotle to the absurdity of producing a purely mechanical and primitive type of motion.

Sense-perception next seems equally mechanical and should entail no error; but, as Aristotle points out, this mechanism breaks down and there is by this theory no real correspondence between the object as it is and as it is perceived by the senses.

Finally, knowledge in the atomic system is reduced to being another kind of sensation, and, although its object is claimed to be 'what truly exists' as distinct from what is perceived by the senses, such knowledge as proposed by Democritus cannot judge truth in its object.

The Structure of Physical Objects

Democritus had explained the structure of physical objects and the phenomenal characteristics which are related to that structure in terms of three kinds of differences which appear among the atoms: ὁμομός, τροπή, διαθιγή. Aristotle cites these very terms and rightly traces them back to Democritus. There is no question here of whether these are themselves terms loaded with Aristotelian implications, for they are not the ones which Aristotle himself uses; they are quite distinct and unique; and Aristotle does indeed offer an explanation for each term and does give what for him would be its

equivalent.⁵ All three of these terms, as von Fritz points out,⁶ are related to concepts of motion, so that, if we accept Aristotle's translations of $\sigma\chi\eta\mu\alpha$, $\theta\acute{\epsilon}\sigma\iota\varsigma$, and $\tau\acute{\alpha}\xi\iota\varsigma$, we are not to imagine these as characteristics of a solid and purely static structure, but rather imagine with Aristotle that we consider their 'position' and 'order' in a given isolated instant of time.⁷

Of these terms, the second (we have already considered $\rho\upsilon\sigma\mu\acute{o}\varsigma/\sigma\chi\eta\mu\alpha$) Democritean word $\tau\rho\omicron\pi\eta$ seems to indicate the direction in which an individual atom is turned at a given instant;⁸ and it thus describes a relationship to another atom or to other atoms, and it is not to be considered as pertaining to one atom in isolation.⁹ The idea of a 'turning' does not seem to make any sense at all if the atom is taken only with regard to itself and is to be thought of completely apart from a reference to some other thing, whether object or atom.

⁵Metaphysics 1.4, 985b4ff.; 8.2, 1042b11ff.

⁶von Fritz, op. cit., pp. 26-28.

⁷Aristotle does not fail to do justice to this dynamic aspect of atoms in constant motion, for he describes their motion as an eternal actuality: $\acute{\alpha}\epsilon\iota\ \acute{\epsilon}\nu\acute{\epsilon}\rho\gamma\epsilon\iota\alpha\nu\ .\ .\ .\ \acute{\alpha}\epsilon\iota\ \gamma\acute{\alpha}\rho\ \acute{\epsilon}\iota\varsigma\alpha\iota\ \phi\alpha\sigma\iota\ \kappa\acute{\iota}\nu\eta\sigma\iota\nu$ --Metaphysics 12.6, 1071b32-33.

⁸This is the way von Fritz, op. cit., p. 28, uses the term: "Vielmehr wendet das Atom jeweils eine seiner Seiten einem anderen Atom zu."

⁹Bailey, op. cit., p. 80, says it indicates "the position of an atom with regard to itself." Wilhelm Schmid, "Der Ausgang der altionischen Naturphilosophie: die Atomistik" in Schmid-Stählin, Geschichte der griechischen Literatur (Munich: 1943), Vol. 2, Part 1, pp. 224-349, simply says, "wie sich I von H unterscheidet." These descriptions are too vague.

In an absolute void there is no permanent place with reference to which the 'turn' can be made; and Aristotle's example as a distinction like that between H and I certainly requires that the term be thought of in relationship to something else. And, furthermore, Aristotle is here concerned with the position of atoms in physical objects as an explanation of the phenomenal qualities of that object--such as color--and it is quite unlikely that most atoms taken in isolation give the impression of any color at all, no matter which way they are turned. Thus, the only reasonable conclusion which one can draw is that both for Democritus' theory and Aristotle's understanding of it, this *τροπή* involves the relation of one atom to another, as Ross had already rightly pointed out.¹⁰

The third term, *διαθεῖν*, is more likely to be connected with the idea of 'touch' (*θίγ*) than with *θῆκη/θεοίς*, as both Bailey and Ross have pointed out,¹¹ in spite of the fact that the relationship of *θίγ* to *θῆκη/θεοίς* might provide an attractive connection with Aristotle's use of the term *θεοίς* in this context. But it is *τροπή* that Aristotle translates as *θεοίς*, not *διαθεῖν*. Bailey's reason for rejecting the connec-

¹⁰Ross, Metaphysics, I, 140.

¹¹Bailey, op. cit., p. 79, note 4; Ross, Metaphysics, loc. cit. John I. Beare, Greek Theories of Elementary Cognition: from Alcmaeon to Aristotle (Oxford: Clarendon Press, 1906), p. 37, note 2, approves the relationship to *θῆκη*. Liddell, Scott, Jones, Lexicon, citing Hesychius, note that it may be related to *διαθεῖν*. Sextus Empiricus, adv. Math. 7.136 (Diels-Kranz 68B9) uses the term *διαθεῖν*, but there that term seems to be used in a meaning which combines both *τροπή* and *διαθεῖν*.

tion of $\theta\iota\gamma$ with $\theta\eta\kappa\eta$ --because "contact with neighboring atoms is so vital an element in Atomic composition"--seems a bit artificial and thus less satisfactory. Still, since the support for a connection with $\theta\eta\kappa\eta$ seems weak and the relationship to $\theta\iota\gamma$ is more obvious and likely,¹² our best course is simply to proceed from that point of view. The element $\delta\iota\alpha$ further indicates a movement 'through' something. So the picture presented by this term is likely to be as follows: as an atom moves on through another group, there is an instant in which the whole group is in a certain order or $\tau\acute{\alpha}\xi\iota\varsigma$, quite apart from the 'side' which they turn to one another.

Of these three Democritean terms which mark the differences which we see in physical objects $\rho\upsilon\sigma\mu\acute{o}\varsigma$ -- $\sigma\chi\eta\mu\alpha$, for Aristotle--seems to be the most basic. I shall, following Aristotle, translate it as 'shape'. In so doing I shall furthermore assume that it includes not only what we might call 'geometrical figure' or 'outline', but 'size' as well. Thus not only will, for example, a cube of a given volume differ 'in shape' from a sphere of that volume, but so also will a sphere of a greater or lesser volume or size. In this sense then all of the traditional elements--particularly earth, air, fire, and water--will differ for Democritus basically 'in shape'.

One issue which Aristotle sees as dividing the 'school of Empedocles' from the 'school of Anaxagoras' is the question

¹²Ross, Metaphysics, loc. cit.

whether the traditional four elements are simple or composite.¹³ And on this particular question at least Democritus may certainly be reckoned as belonging to the 'school of Anaxagoras'; for Democritus did take some account of the four elements, and for him these--just like every other physical object--were composite, composed of indivisible bodies: ἐκ σωμάτων ἀδιαίρετων τᾶλλα συγκεῖσθαι φασί.--Gen. et Corr. 1.1, 314a21-22.

Thus, since for Democritus there is no essential difference between the structure of the traditional elements, or simple bodies, and that of other physical objects (other, perhaps, than complexity), and since Aristotle is more interested in and gives more information about Democritus' view of the elements, we might then use the structure of these elements as a prime paradigm of the structure of all physical objects. And this will further imply that any valid criticism leveled by Aristotle against such a theory of structure will also apply with equal force against any and all physical objects so structured.

Of the traditional elements 'fire' for Democritus is a special case, for to it alone of the elements Democritus assigned a specific 'geometrical figure', the sphere.¹⁴ But in what sense then is fire to be characterized by the spherical

¹³Gen. et Corr., 1.1, 314a25-30.

¹⁴For example, Caelo 3.4, 303a14: μόνον τῷ πυρὶ τὴν σφαῖραν ἀπέδωκεν. Also Anima, passim; for example, 1.2, 404a1ff. and 405a12-13.

shape? The spherical shape is the most mobile of the atomic shapes (εὐκίνητοτατον -- Anima 1.2, 405a12), and for that reason it above all is constantly in motion (διὰ τὸ πεφυκέναι μηδέποτε μένειν -- Anima 1.3, 406b21); and as a sphere it has a particular ability to penetrate everywhere and thus to divide and impart some of its high mobility to other atoms.¹⁵ And it is likely in this sense--in the sense that it particularly penetrates, sets in motion, and divides--that the sphere is sort of an angle and so 'cuts'.¹⁶

'Heat' is evidently for Democritus the sensation which is produced in us by the highly motive and dividing power of the spherical atoms; and this is in principle no different from making the flavors as we taste them effects in us of specific other atomic shapes.¹⁷ In his On the Soul 1.2, 403b30ff., Aristotle rightly claims that Democritus made the soul, inasmuch as it is composed of spherical atoms, warm, because those atoms are particularly in motion and produce in us the sensa-

¹⁵ Anima 1.2, 404a7-8: διὰ τὸ μάλιστα διὰ παντὸς δύνασθαι διὰδύνειν τοὺς τοιούτους ῥυσμούς. One might note here the use of Democritus' own term for 'shape'; compare also David Ross, Aristotle De Anima (Oxford: Clarendon Press, 1961), p. 175; also W. K. C. Guthrie, History, Vol. 2, p. 430, note 5.

¹⁶ Caelo 3.8, 307a17-18: ὡς γωνία τις οὖσα τέμνει ὡς εὐκίνητον. The angle cuts because of its acuteness, but the sphere cuts because of its mobility and its ability to set other atoms into motion.

¹⁷ Sensu 4, 442a31ff. Schmid, op. cit., p. 272, claims that this makes the spherical atom fiery and so negates the atomists' monism: "den Begriff des Monismus tatsächlich aufhebt." But the fact that the atom produces this sensation (heat) does not mean that the atom itself is hot.

tion of heat.¹⁸ Thus fire is hot because its spherical atoms in abundance produce that sensation in us by their movement. The sphere is thus for Democritus precisely what makes the moving soul motive and what moves the animate body; the spherical atoms in it give both fire and soul their primary characteristics.

This is not to say that any single small spherical atom taken in isolation is fire or even a small piece of fire, any more than this was so for Anaxagoras. Fire, like each of the other traditional elements was for both Anaxagoras and Democritus a composite. The small spherical atom taken individually was to be found as part of the air we breathe;¹⁹ it is likely to exist in the aqueous nature of the eye, if there is to be 'soul' there sensitive to visual images,²⁰ and to be in the sea: Meteorology 4.1, 379b4ff. speaks of atoms left as a residue of 'putrefaction' which provide the basis for animate life, although there is here no explicit statement attributing

¹⁸ τῶν κινουμένων τι τὴν ψυχὴν ὑπέλαβον εἶναι. ὁθεν . . . πῦρ τι καὶ θερμόν φησιν αὐτὴν εἶναι. This is not to say that soul, fire, and 'what is hot' are in all respects identical, as Cherniss, op. cit., p. 298, note 3, seems to assume that Aristotle wrongly does, but only that they are in some respects identical.

There may indeed be an effect of 'heat' produced in us by a single spherical atom, although that effect may very well simply go unnoticed--and it may indeed be noticed only when there are a goodly number of such spherical atomic shapes producing the same effect in us.

¹⁹ This is to replenish the supply of 'soul-atoms' which are constantly escaping from us; on this matter see Resp. 4, 471b24ff. and Anima 1.2, 403b31ff.

²⁰ Sensu 2, 438b5ff.

this to Democritus.²¹ Indeed, their existence in the universe at large seems to be pretty strongly implied.²² Now this spherical atom, or any random number of them--inasmuch as they are part of air or water or any other element or compound--is not fire, nor does Aristotle say that it is.²³ Only in speci-

²¹But compare Caelo 4.6, 313a24ff., where Democritus claims that warm particles rise up out of water.

²²And thus the criticism of Aristotle at Anima 1.5, 411a7ff. seems to apply to Democritus as well as to others.

²³Cherniss, op. cit., p. 289, note 3, claims that Aristotle does. But what Aristotle does say is that soul and fire are the same in that they contain the same matter, spherical atoms (see Resp. 4, 472a35), that soul is 'fire of a sort' ($\pi\upsilon\rho\ \tau\iota$), that soul and fire have some characteristics in common. But this does not imply total identity; and Cherniss seems wrong in assuming that Aristotle jumped to unwarranted conclusions. Nor does Aristotle say, as Cherniss says he does, that the atom was hot; soul and fire and the spherical atom are only 'hot' in the sense that they produce that sensation in us.

The passage in which Aristotle seems to come closest to saying that the spherical atom is hot is Gen. et Corr. 1.8, 326a5 (though Cherniss does not cite this passage here). This passage will be taken up later, but we might say this much about it now: what Aristotle does say is that Democritus assigns 'what is hot' (i.e., what produces the effect of heat) to the spherical figure; and what is illogical about that attribution is not that it is assigning a quality as a property to supposedly qualitless atoms (that would have immediately produced a self-contradiction in Democritus which Aristotle would not have failed to notice), but that Democritus does not assign 'what has a cold effect' to a contrary figure.

Aristotle raises a second and separate objection to Democritus' atomism at 326a7ff. Aristotle there points out that if one assigns one set of contraries to atoms--such as degrees of heat and cold (and this Democritus did not do)--then it is illogical not to assign other sets of contraries to those atoms as well. But Democritus, he says, did assign varying degrees of weight to his atoms (with the weight increasing as the size increases). And so, Aristotle says, if weight is assigned to them in degrees, then degrees of heat (apparently varying with the shape) ought also be assigned to them as a property; and if these properties belong to them in degrees, then so might softness and hardness; and, if the latter, the atom can be affected.

fic--though, as far as we know, unspecified--combinations do these spherical atoms become what we perceive as fire and call fire. And we might further assume that such a combination includes their being rather highly concentrated, since their heat is obviously more intense than the warmth of the soul or of the air.

The further question as to whether only spherical atoms constitute what we know as fire or whether such fire is composed of non-spherical atoms as well--with the spherical predominating--is unanswered by Aristotle and by later tradition about Democritus; and the answer to this question may not indeed be essential. It does, however, seem more likely--if Democritus had carried his inquiry about fire that far--that any given and observed example of fire, inasmuch as it is the burning and dissolution of some object, might grow both by releasing further spherical atoms already in the object and by setting non-spherical atoms into violent motion. And these latter non-spherical atoms may very well have been considered as part of the phenomenon which we call fire. In any case, the essential part of fire, that which primarily gives it its nature, is the spherical atom.

The other traditional elements--earth, air, and water--are composite as well, although, unlike fire (for which a specific geometrical figure determines the character) their nature is determined by the size of the atoms of which they are

constituted.²⁴ But this does not prevent them from--like fire--being differentiated from one another by 'shape' (ῥυθμός).²⁵ And, since it is the size of the atom which determines the nature of the element, its 'geometrical figure' may vary greatly, and so present a great variety of sense-data to us. Water may thus taste bitter or sweet depending on the 'geometrical figure' predominating in the atoms of the water tasted without really affecting its nature as water.

The differentiation between 'elements' on the basis of the size of atoms making up any element is not to be taken to mean that a given element is composed of atoms all of one size; rather any one element must contain atoms in a variety of sizes. For Democritus, air, for instance, must contain not only spherical atomic shapes, but also both larger and smaller atoms--enough of a supply and variety to provide for the generation of water from air, for it is precisely in connection with this differentiation by size that the mutual generation of elements from one another is formulated.²⁶ If one element is to be generated from another by the separating out of the larger atoms, as they claim, then each element must contain the

²⁴Caelo 3.4, 303a26-27: μεγέθει καὶ μικρότητι διαφέρειν ἀέρα καὶ γῆν καὶ ὕδωρ.

²⁵On Melissus, Gorgias, and Xenophanes 2, 975b28 claims that Democritus said that also water and air and each of the multitude of things, though their material is generically the same, differ in shape: τὸ ὕδωρ τε καὶ τὸν ἀέρα ἕκαστόν τε τῶν πολλῶν, ταῦτ' ὄν, ῥυθμῷ διαφέρειν.

²⁶Caelo 3.4, 303a27-29: τὰ μέγιστα σώματα ἐκκρινόμενα, φασὶ δ' οὕτω γίνεσθαι ὕδωρ καὶ ἀέρα καὶ γῆν ἐξ ἀλλήλων.

sizes of atoms requisite for any other element;²⁷ and the differentiation between the elements by size of atoms must mean that one element is distinct from another because one particular size of atom predominates among the variety, there being more of that particular size either than of all other sizes or than of any other size. So the nature of any element is determined by the proportionate mixture of the various kinds of atoms in it.

Furthermore, the so-called elements in the traditional sense, Democritus claims, are not limited to four in number; indeed, there is a limitless number of them, as Aristotle reports in a number of passages.²⁸ And this claim is quite con-

²⁷Whether this sort of variety also holds true of fire is, as was mentioned, in doubt. Fire is not mentioned in this mutual generation. But the argument from silence, though strong--especially when taken together with the unique position of fire in being assigned a special geometrical figure--is still not absolutely conclusive. It is certainly likely that fire may be generated from other objects; but the reverse process is more in doubt.

²⁸In some of these passages there may be some preliminary doubt whether Aristotle's term στοιχεῖον refers to the atom or to the 'traditional elements' which for Democritus are composites; the latter seems the case in these passages.

At Physics 3.4, 203a20 Aristotle says that Anaxagoras and Democritus make the elements limitless (ἄπειρα ποιοῦσι τὰ στοιχεῖα), and these, Aristotle says, Democritus forms from atoms: ὁ δ' ἐκ τῆς πανσπερμίας τῶν σχημάτων (what is meant by πανσπερμία will be taken up later).

At Caelo 3.4, 303a13 Aristotle says that the atomists ἄπειρα καὶ τὰ ἅπλᾳ σώματά φασιν εἶναι. The σώματα are evidently not atoms here; their limitlessness had already been established (303a5-6), and this is an additional point (καὶ πρὸς τούτοις --303a11); the σώματα must be the traditional elements, as what follows shows--a discussion of fire, water, and such (again, interestingly enough πανσπερμία is mentioned).

At Gen. et Corr. 1.1, 314a22-24 Aristotle says that the atomists ἐκ σωμάτων ἀδιαίρετων τάλλα συγκεῖσθαι φασί, ταῦτα δ'

sistent with Democritus' view of the mutual generation of the elements; for any one element by the addition or subtraction of a single atom would have the proportion of atoms in it changed, and thus its essential nature would be changed; it would thus become a different element. Thus, with the wide variety of possibilities of change inherent in such a system, the number of possible elements would quite consistently seem limitless.

In connection with Aristotle's explanation of Democritus' theory of the mutual generation of the elements at On the Heavens 3.4, the term πανοπερμία had been used and was seen to recur in other pertinent passages as well, indeed, more in connection with Democritus than with Anaxagoras, with whom the term is more usually connected. Although it seems appropriate to the teaching of Anaxagoras as well, Trendelenburg²⁹ suspects

ἄπειρα καὶ τὸ πλῆθος εἶναι καὶ τὰς μορφάς, αὐτὰ δὲ πρὸς αὐτὰ διαφέρειν τούτοις ἐξ ὧν εἰσὶ καὶ θέσει καὶ τάξει τούτων. The ταῦτα, I take it, refers to τὰλλα, and so does αὐτά; αὐτά is to be taken as ἀλλήλα, compare Verdenius and Waszink, op. cit., p. 1. The τούτοις and τούτων obviously refer to atoms; thus I would translate this passage as: "It is out of indivisible atoms that they say (any) remaining objects are composed, and these objects are limitless in multitude and in their structure and they differ from one another in three respects, by the atoms which compose them and by the placement and order of these atoms." And once again πανοπερμία is mentioned in this context. Compare also Hermann Langerbeck, Doxis Epirhysmie: Studien zu Demokrits Ethik und Erkenntnislehre (reprinted at Frankfurt am Main: Weidmann, 1967), p. 99.

²⁹In his commentary on De Anima, p. 214, as cited by G. R. T. Ross, Aristotle De Sensu and De Memoria (Cambridge: University Press, 1906), p. 163. Joachim, op. cit., p. 66, also agrees, although it seems that most modern scholars prefer to connect the term with Anaxagoras, if they commit themselves at all to connecting it with one of the two.

that the term is Democritean and is quite appropriate to Democritus' view of the traditional elements.³⁰ Therefore it seems fitting to survey briefly its use and its applicability to the teachings of Democritus, with the expectation that it will help clarify those teachings.

Outside of Aristotle and his commentators the word is used in philosophical contexts as early as Plato, Timaeus 73c, where the god mingled triangles capable of producing the four elements and thus contrived a πανοπερμία;³¹ thus, interestingly enough, it refers here to a mixture in which the constituent parts of the four elements are present. Plutarch says that for Zeno the θυμὸς was a πανοπερμία of 'passions', a mixture drawn from the various faculties of the soul.³² In Lucian's Hermotimus, 61, philosophy is like a πανοπερμία, a sack with all sorts of grains in it; a seller may take out some of the grains to show a prospective buyer a sample, but one cannot tell what the other grains are like just from this sample;³³ each part of the πανοπερμία shows something differ-

³⁰Guthrie, History, II, 414, says that Aristotle used the term "somewhat carelessly" in connection with Democritus.

³¹τριγώνων ὅσα πρῶτα . . . πῦρ τε καὶ ὕδωρ καὶ ἀέρα καὶ γῆν . . . μάλιστα ἦν παρασχεῖν δυνατόν, ταῦτα ὁ θεὸς . . . μειγνύς . . . πανοπερμίαν παντὶ θνητῷ γένει μηχανώμενος.

³²Moralia, De Cohibenda Ira, 463a.

³³The point of the comparison is that philosophy is not like a skin of wine, the same throughout, from which you can take one sip and thus judge all the rest of the wine in the skin; but it is like a sack filled with all sorts of grain, all of which one must examine in order accurately to determine the nature of the whole.

ent, and one cannot tell about the whole until one examines all of it. This passage is interesting in that the grains may provide close parallels with atoms in a conglomeration. In general it seems best to say that this term describes a mixture of a great number of various and distinct parts, some of which, when isolated, give us only an incomplete knowledge of the whole. Thus far it seems that the term can apply with equal appropriateness to the teachings of both Democritus and of Anaxagoras, and there is no reason in usage outside of Aristotle for applying it to one in preference to the other. Indeed, tradition has it that Democritus was a pupil of Anaxagoras, and they may well be close together on this subject.³⁴

This brings us to the usage of that term in Aristotle himself. At Physics 3.4, 203a16ff. Aristotle is talking about the traditional elements (τῶν λεγομένων στοιχείων, οἷον ὕδωρ ἢ ἀέρα ἢ τὸ μεταξὺ τούτων --203a17-18); and Aristotle then adds some information on how Anaxagoras and Democritus thought of these traditional elements; both held that they were composite. Anaxagoras taught that any such element was further composed of more basic bodies which Aristotle calls ὁμοιομερῆ, bodies whose parts are like the whole; and the traditional elements for him were not such basic bodies. Democritus, on the other hand, is said to have held that any such traditional element is a composite as well, consisting of the seed (or atom) combination of all atomic shapes (ἐκ τῆς παν-

9.34. ³⁴See Diogenes Laertius, Lives of Eminent Philosophers.

σπερμίας τῶν σχημάτων).³⁵ Aristotle then goes on to describe the nature of the ὁμοιομερῆ and how the generation of objects (and 'elements') were explained in Anaxagoras' terms (203a23-33); he then continues and does the same for Democritus' theory very briefly (203a33-b2). But this description of Democritus' view, I believe, presents a difficulty which may be better postponed until we have considered at least one more passage in which Aristotle uses the term πανσπερμία. But, so far at least, we may say this much about πανσπερμία in Democritus: it describes for him the nature of the traditional element;³⁶ πανσπερμία, it seems, ought to be connected with Democritus' theory of the mutual generation of the elements,³⁷ for, since the element contains--as πανσπερμία--all the shapes or sizes necessary for its generating other elements, it was obviously meant to explain, for one thing, such mutual generation.

At On Sensation 4, 441a4-11 Aristotle gives three theories as to how 'tastes' may originate from water; the first of these is specifically connected with the name of Empedocles, and the second describes water as a πανσπερμίαν χυμῶν, but is

³⁵Note here that the term πανσπερμία is used explicitly in connection with Democritus and in contrast to Anaxagoras, with whom this word is more usually connected.

³⁶Ross mentions nothing at all about the nature of the 'element' as related to πανσπερμία.

³⁷I have not seen in any of the modern accounts any attempt to consider these two theories in conjunction with one another.

assigned to no one in particular. In both of these theories it seems implicitly agreed that the water in question presents no particular flavor to us, but is itself still responsible for flavors in other things, as, for instance, in the plants that 'feed on' it.³⁸ Each of these two theories have been ascribed to Democritus.

Although Empedocles is specifically mentioned in connection with the first of these theories, Cherniss argues that, since the second is obviously that of Anaxagoras, it is better to connect Democritus with the first.³⁹ The first theory then is that "the water has in it (various) kinds of flavors which are imperceptible due to their size."⁴⁰ But, if this theory is to be distinct from the second, it implies, as nearly as we can tell from the statement of the theory and from Aristotle's criticism of it, that any given amount of water--for example, any amount of water from a specific source--has in it a specified and unvarying (as long as the general conditions are constant) flavor in it; the 'kinds' of flavors may vary as the source of the water varies, but the flavor of that specific

³⁸The third theory, that the responsibility for the taste is to be sought outside the water, need not concern us here.

³⁹Op. cit., p. 320, note 116, probably because here the 'kinds of flavors' are "imperceptible because of their small size;" there seems to be no real reason beyond this. But it is also implied in the second theory that the taste in the water is too small to be perceived.

⁴⁰ἐν αὐτῷ τὸ ὕδωρ ἔχειν τὰ γένη τῶν χυμῶν ἀναίσθητα διὰ μικρότητα --441a5-6.

supply of water stays the same. This flavor 'comes out' in the fruit of the plant which gets its water from that source; and the flavor apparently becomes noticeable as it becomes more concentrated in the fruit. That which distinguishes this theory from the next is that the flavor lurking in any given source of water is constant. Aristotle refutes this by saying that any given fruit can by cooking, drying, and other processes acquire a great variety of flavors. And this is the theory which Cherniss would ascribe to Democritus. But it is quite well agreed that for Democritus contraries are present in the same object; and this was on the particular basis of empirical observation.⁴¹ But this first theory seems to allow less lee-way on the variation of the flavor of the same water than would seem appropriate to Democritus' theory.

The second theory is that water provides the material for flavors and so is an (atomic) seed-combination of all flavors. Alexander in his commentary, although he admits that the theory is Anaxagorean,⁴² still connects it with Democritus; and he is, I believe, right in doing so. Democritus is mentioned in this same chapter of On Sensation as reducing the

⁴¹Meta. 4.5, 1009a23ff. Contraries may be true of an object because the full and the void (contradictories) are at any given part of the physical object; any object may also present contraries to us because the shape, placement, and order of the atoms may differ at any part of the object: "ἐν εἰσσι, οὐκ ἔστι, τὰς αἰσ. ταῦτα δὲ γένη ἐναντίων --Physics 1.5, 188a23-24.

⁴²Page 68 (as cited in Ross, Sensu, p. 163, and Cherniss, op. cit., p. 320, note 116).

flavors to 'shapes';⁴³ and, if we substitute σχημάτων for χυμῶν in 441a8, we have precisely the expression used in the above-mentioned passage in the Physics describing Democritus' theory of the elements: πανσπερμία σχημάτων. Water, we have seen, is differentiated from other elements only by the size of its atoms, with the geometrical shapes likely remaining varied; this means that any given portion of water (no matter what the source) may have a variety of atomic shapes, with the largest number of a given geometrical figure determining the flavor that we may taste in the water or in the plant.⁴⁴ The atoms may differ from part to part in the water, and so one portion of water may give rise to one flavor and another portion to another flavor: ἄλλα δ' ἐξ ἄλλου μέρους --441a21-22. The theory and its refutation seem appropriate enough to Democritean atomism.⁴⁵

Upon noting at On Sensation 4, 441a9 that for Democritus different flavors may arise at different parts of water due to there being a predominance of a specific kind of geometrical figure in one portion and a predominance of another kind of atomic figure at another portion of water, we are ready now to

⁴³4, 442b13.

⁴⁴Compare Beare, op. cit., p. 166. He agrees with Alexander that this passage applies to Democritus and states that the atoms of taste have their noticeable effect as a group with "the predominating kind fixing the quality of the whole." See also Ross, Sensu, p. 163.

⁴⁵Ross, Sensu, p. 164, assigned the third theory mentioned in this passage to Anaxagoras.

return to the account at Physics 3.4, where at 203a33-b4 we have a parallel explanation of 'traditional elements' in general for Democritus. There Aristotle claims: "But Democritus (in contrast to Anaxagoras) says that none of his primary bodies (atoms) comes into being out of another."⁴⁶ Now, in spite of this permanence of the atoms, we nevertheless do have some account of the 'traditional elements' quite like that of Anaxagoras to explain the varied phenomena of the world. The text, according to Ross, is as follows: ἀλλ' ὁμῶς γε αὐτῷ τὸ κοινὸν σῶμα πάντων ἐστὶν ἀρχή, μεγέθει κατὰ μέρη καὶ σχήματι διαφέρον. Ross, following Simplicius here,⁴⁷ takes τὸ κοινὸν σῶμα as 'the body that is common to all atoms' or 'the universal bodily substance',⁴⁸ and claims that this 'common body' differs in size and shape in its parts. This is indeed a strange way to say that atoms are one in kind, but differ in shape and size; and hence one might well hesitate to accept such an interpretation. Furthermore, neither Ross nor Simplicius gives any really satisfactory explanation of what is

⁴⁶ Δημόκριτος δ' οὐδὲν ἕτερον ἐξ ἑτέρου γίνεσθαι τῶν πρῶτων φησὶν. Or, perhaps, since the contrast is to Anaxagoras, a better translation would be: "No atom is composed of 'sub-atoms'." The argument of Zeno might well have convinced Democritus of this. But in either case the point is that an atom is and remains the same, a permanent actuality.

⁴⁷ Ross, Physics, p. 546; see also Simplicius, In Physicorum, p. 462, lines 12-13: καθόσον τὸ κοινὸν σῶμα τὸ τῶν ατόμων ἐν πάντων ἔλεγε τὴν διαφορὰν αὐτῶν κατὰ μέγεθος καὶ σχῆμα τιθεῖς.

⁴⁸ Ross, Physics, p. 363.

meant by κατὰ μέρη, 'in their various portions'.⁴⁹ Aristotle had told how for Anaxagoras the elements, being composed of ὁμοιομερῆ, can account for mutual generation and, from there, the generation of everything else; so what we are looking for here is some similar explanation in the case of the 'elements' for Democritus, as being constituted as a πανοπερμία of shapes; and this, I believe, we have at 203a34-b2.

The πανοπερμία τῶν σχημάτων of 203a21-22 seems to be taken up again with the phrase αὐτῶν τὸ κοινὸν σῶμα.⁵⁰ This πανοπερμία σχημάτων, this common body which contains (or, is shared by) a great variety of atoms, does indeed provide an explanation of the mutual generation of the elements--or, of the generation of anything else for that matter--and it can do so because any given portion of it contains a variety of atoms which differ in size and in geometrical figure. And this is precisely the kind of explanation which the context in this passage would lead one to expect to find; it justifies the linking of Anaxagoras and Democritus, and it points out as well exactly where the difference between their doctrines lies--

⁴⁹Simplicius says nothing at all about this. Ross, Physics, p. 363, in his 'analysis', writes: "whose parts differ only in size and shape," which I can only take to mean that the parts (i.e., atoms) of this universal bodily substance differ in shape. The Oxford translation of Hardie and Gaye, "differing from part to part in size and shape," is of no real help either.

⁵⁰I accept, along with Henri Carteron, Aristote Physique, I, 97, the reading of manuscript E over against the reading of J, which Ross accepts. Simplicius, In Physicorum, p. 462, line 12, seems to agree with E; he has: τὸ κοινὸν σῶμα τὸ τῶν ατόμων.

primarily in the continuing actuality of the atom for Democritus.⁵¹

There is in the Generation of Animals another passage which involves πανοπερμία; and I suspect that this may very well also belong to the teaching of Democritus; nothing that I can see would prohibit it from being identified with him; it would be quite consistent with the rest of his theory. But, be that as it may, if this particular theory does not in fact belong to Democritus, it is at the very least an excellent illustration of what πανοπερμία likely meant for Democritus as well as being a good indication of what this term did mean for Aristotle.

Democritus had taught that a child is born a male or a female according as the seed from either parent prevails; for instance, male, if the seed of the father is predominant (κρατῆρον--Gen. Anim., 4.1, 764all). The semen of both mother and father are factors to be reckoned with in determining at least the sex of the offspring. And this theory is mentioned again at 4.3, 769a18-19. And several lines after this, though no specific theorists is mentioned, the matter of parental semen being a πανοπερμία is introduced as a possible explanation of a number of other differences which may occur in the

⁵¹ Compare Schmid, op. cit., p. 229: "Von der πανοπερμία des Anaxagoras unterscheidet sich die Atomwelt dadurch, dass die Teilbarkeit des anaxagorischen Stoffes unbegrenzt und dass in jedem seiner Bestandteile die ganze Fülle der empirisch vorhandenen Einzelstoffe enthalten ist und aus ihm herausgebildet werden kann."

offspring, which is in some respects like the father and in other respects like the mother; so the semen of each is in fact a sort of combination of a larger number of ingredients. Peck translates Aristotle's explanation quite adequately:⁵²

"It is as though someone were to mix and blend a large number of juices into one fluid, and then take off some of this mixture; in doing so he could take off not always an equal amount of each juice, but sometimes more of this one, sometimes more of that, and sometimes he might take some of one and nothing of another: So, they say, it is with the semen which is a mixture of a large number of ingredients; and in appearance the offspring takes after that parent from whom the largest amount is derived."

The parallels to the explanation of the constitution of water in On Sensation--as well as to the sack of all sorts of grain in Lucian--is striking.⁵³ Α πανοπερμίσ would then be a combination of all sorts of atoms, with the dominant kind determining the nature of the substance; one may take out a portion of these (at random) and thus have a substance with different qualities on two different occasions--with some one kind now predominating and determining its nature, now some other kind. One can in this way account for a seemingly limitless number of differences in what appears to be basically the same sub-

⁵²A. L. Peck, Aristotle Generation of Animals (London: William Heinemann, 1963), pp. 415 and 417: 4.3, 769a29-36--
ὡπερ οὖν εἴ τις κεράσειε πολλοὺς χυμοὺς εἰς ἓν ὑγρὸν, κάπειτ' ἐντεῦθεν λαμβάνοι, καὶ δύναιτ' ἂν λαμβάνειν μὴ ἴσον ἀεὶ ἀφ' ἑκάστου, ἀλλ' ὅτε μὲν τοῦ τοιοῦδε πλεόν ὅτε δὲ τοῦ τοιοῦδε, ὅτε δὲ τοῦ μὲν λαβεῖν τοῦ δὲ μὴθὲν λαβεῖν - τοῦτο συμβαίνειν καὶ ἐπὶ τῆς γονῆς πολυμιγοῦς οὕσης· ἀφ' οὗ γὰρ ἂν τῶν γεννῶντων πλεῖστον ἐγγένηται, τοῦτ' ὅτι γίνεσθαι τὴν μορφήν ἐοικός.

⁵³Compare, for example, εἰς ἓν ὑγρὸν at 769a30.

stance.

In On Generation and Corruption 1.1 the term πανσπερμία is connected more closely with the name of Anaxagoras, and it is with this connection that most commentators feel more comfortable. In this chapter Aristotle raises the question as to whether the traditional elements are simple or composite. The issue is drawn between two 'schools'--that of Empedocles and that of Anaxagoras.⁵⁴ It is the school of Anaxagoras that claims that the traditional elements are composite (σύνθετα--314a29): πανσπερμίαν γὰρ εἶναι τούτων --for each of these traditional elements, they claim, is a "mixture of all sorts of seeds;" and for Anaxagoras himself those seeds are the ὁμοιομερῆ.⁵⁵ That Democritus himself belongs to the 'school of Anaxagoras' in respect to the composite nature of the traditional elements is certain enough; and he had indeed been mentioned immediately prior to this remark by Aristotle on the controversy between the schools, and there (314a22-24) Aristotle quite clearly claims that Democritus taught that every-

⁵⁴1.1, 314a24-26: ἐναντίως δὲ φαίνονται λέγοντες οἱ περὶ Ἀναξαγόραν τοῖς περὶ Ἐμπεδοκλέα. One might note that even in this passage Aristotle makes no specific and unique identification of the term with Anaxagoras. Verdenius and Waszink, op. cit., p. 1, specify Anaxagoras in spite of this, likely because both Anaxagoras and the ὁμοιομερῆ have been mentioned. But Aristotle, I believe, sees the issue as a larger one than the debate between two persons; two schools of thought are mentioned.

⁵⁵Following Verdenius and Waszink, op. cit., p. 1, and against Cherniss, op. cit., p. 108, note 444, who takes the τούτων as referring to composite objects and not to the ὁμοιομερῆ.

thing else beside the atoms--and that includes the 'elements'-- is a composite: ἐκ σωμάτων ἀδιαίρετων τᾶλλα συγκεῖσθαι φασί. So here, though the term πανσπερμία seems more closely connected with Anaxagoras, it is not specifically and uniquely identified with him; and Democritus even here is still connected with it as much as Anaxagoras is.

In On the Heavens 3.4 the teaching about the element as a πανσπερμία is a little more closely connected with the mutual generation of the elements. At 303a13 Aristotle mentions in regard to the structure of the traditional elements that Democritus had assigned the spherical atomic shape to fire; "but he and Leucippus distinguished air, water, and the other elements from one another by the largeness and smallness of the atoms which constitute them: ἀέρα δὲ καὶ ὕδωρ καὶ τᾶλλα μεγέθει καὶ μικρότητι διεῖλον.⁵⁶ This, as we have seen, means that Democritus distinguished the elements from one another by positing a predominance of a specific size of atom for a specific element; and he did not differentiate them by claiming that all the atoms of a given element are of a uniform size or shape. And Democritus made this kind of a distinction between these elements "on the ground that each element is by nature a sort of a 'mixture of all sorts of seeds'--the seeds necessary for all of the traditional elements."⁵⁷ The matter of distinguish-

⁵⁶303a14-15.

⁵⁷303a15-17. Guthrie, op. cit., p. 414, takes στοιχείων here to refer to the atoms and concludes that Aristotle is here using the term πανσπερμία somewhat carelessly. But I take it

ing 'elements' by size of atoms is repeated at 303a25ff. along with the claim that for Democritus there was a mutual generation of the elements by the separation out of the larger atoms. The elements thus were distinguished by 'size' and not specifically by geometrical figure--except, of course, for fire. There were in any mixture which constitutes an element all sorts of geometrical figures; and the proportion of geometrical figures in one element seems to remain pretty much the same when another element is generated from it by the removal of some atoms of a specific size.⁵⁸ πανοπερμία is thus a term quite closely connected with the name of Democritus and indicates a mixture capable of producing all the elements, for it has all the necessary kinds of atoms.

This leaves us with one more important passage to account for, in which the doctrine of πανοπερμία is connected with Democritus; the passage is at On the Soul 1.2, 404a4. I have postponed considering this passage because it is the subject of much controversy; the meaning of the passage is in doubt;

that the seed-mixture needs to be thought of as one that at least in a preliminary way may supply seeds for all the elements in mutual generation and still have each new element retain a roughly similar proportion of shapes (i.e., geometrical figures). Leo Elders, op. cit., p. 302 fails to explain this altogether, only indicating that the word has reference to some primitive state in which all kinds of atoms were together.

⁵⁸This seems to be what Simplicius, de Caelo, p. 610, lines 24ff., makes of this passage: οὐκέτι κατὰ τὸ σχῆμα διαφερόντων, ἀλλ' ἐκ παντοδαπῶν σχημάτων καὶ τῶν αὐτῶν ἐκδο- του τούτων γινομένου -- "No longer [as is the case with fire] differing by geometrical figure, but composed of all sorts of geometrical figures which remain constant when each of these [elements] is generated." Additions mine.

and, indeed, as a result of that doubt, a number of attempts have been made to manipulate and excise portions of the text. The following is the text as it appears in Ross' edition (403b31-404a6):

ὅθεν Δημόκριτος μὲν πῦρ τι καὶ θερμόν φησιν αὐτὴν εἶναι· ἀπείρων γὰρ ὄντων σχημάτων καὶ ἀτόμων τὰ σφαιροειδῆ πῦρ καὶ ψυχὴν λέγει (οἷον ἐν τῷ ἀέρι τὰ καλούμενα ξύσματα, ἃ φαίνεται ἐν ταῖς διὰ τῶν θυρίδων ἀκτῖσιν), ὣν τὴν μὲν πανσπερμίαν στοιχεῖα λέγει τῆς ὅλης φύσεως (ὁμοίως δὲ καὶ Λεύκιππος), τούτων δὲ τὰ σφαιροειδῆ ψυχὴν . . .

Ross⁵⁹ summarizes the dissatisfaction with this text as it stands on the grounds that the sentence is a muddle, because 1) the antecedent of ὣν ought to be 'spherical atoms' or 'fire and soul', while the sense requires it to be 'atoms', and 2) it makes Aristotle say twice that Democritus identified soul and the spherical atom. Diels had tried to remedy the situation by excising most of the offending portion of the text: τὰ καλούμενα . . . ἀκτῖσιν ὣν.⁶⁰ Cherniss agrees that the passage is certainly corrupt.⁶¹ Brieger has apparently made a more constructive attempt⁶² by proposing that the ξύσματα are to be pictures of the atoms in general, and not of spherical atoms specifically; thus the ξύσματα are the antecedent of ὣν. This thus meets Ross' first objection; but he is still left with assuming a lacuna in the text. Langer-

⁵⁹Ross, Anima, pp. 174-175.

⁶⁰Diels-Kranz, 67A28, II, 78.

⁶¹Op. cit., p. 290, note 4.

⁶²A. Brieger, "Demokritos' angebliche Leugnung der Sinneswahrheit" Hermes, XXXVII (1902), p. 72, note 1.

beck⁶³ has followed a similar course; the ζύματα, he says, are atoms in general and, as such, are themselves in constant motion; and the special motion of the spherical atoms is due to their shape. Thus he manages his interpretation without assuming any basic change in the text as received. But even so he does not meet Ross' second objection to the text as it stands, and he neglects the meaning of πανοπερμία here.

Both of Ross' objections ought to be met; and I believe that this can be done without any real change in the text. Now the only way in which the second objection can be met is to extend the comparison--or, rather, illustration--through the second identification of the spherical atoms with soul. The first objection can be met, as has been pointed out, by taking ζύματα as the antecedent of ὧν. But this means that we do not have here a comparison or simile, but an actual illustration, meant to be taken literally. The ζύματα are not like atoms, but are in fact combinations of all kinds of atoms, including spherical; they are themselves πανοπερμία: containing spherical atoms which give them their movement. Thus the thought of the whole passage, including the context, would be something like this: Some have said that soul is primarily that which causes motion and can only do this by itself being

⁶³Op. cit., pp. 78-79. His interpretation avoids making the particles an equivalent of soul, as some Pythagoreans had done; and it was the fact that this made the teaching of Democritus the same as the teaching of the Pythagoreans that gave Diels his excuse to excise the passage where this doctrine is attributed to Democritus.

in motion (403b28-31); this led Democritus to say that the soul was a sort of fire (403b31-404a1), because, though there is a limitless number of atomic shapes, the spherical shapes are what constitute both soul and fire (404a1-3); this is the case with the (moving) particles in the air, for each particle has a 'mixture of all kinds of atoms'--a mixture which for Democritus would be an 'element'--and in this mixture the spherical atoms are what moves it, its 'soul' (404a3-6); and this is quite like what the Pythagoreans say, for some of them say that these ξύματα are soul, and others that what moves these ξύματα is soul, moving them even when the wind is calm (404a16-20).⁶⁴ Democritus has thus taken a Pythagorean doctrine and explained it in atomic terms.

Thus the structure of the traditional elements is described in Democritus' teaching by the term πανοπερμία as a combination of atoms of a great variety of shapes (that is, both size and geometrical figure). While this is primarily true of

⁶⁴I would thus translate the passage cited above (p. 174) as follows: "(Assuming that what is soul is in motion--ὄθεν) Democritus says that soul is a sort of fire and what is warm, for, although the number of atomic shapes is limitless, he claims that the spherical atoms are both fire and soul; this is the case (he says) with the so-called particles (moving) in the air, particles which appear in sun-beams which come in through windows; he claims that the 'mixture of all sorts of atoms' of these particles are the elements of the whole of nature--Leucippus does too--and that the spherical atoms in these particles are their soul (i.e., that which gives them their movement)." This translation and interpretation has the advantage of taking ὡν τὴν μὲν πανοπερμίαν στοιχεῖα λέγει . . . καὶ Δεύκιππος as appropriate to the context. By the other interpretations the remark would simply need to be taken as repetitious and parenthetical.

the elements, or simple bodies, other physical objects are in principle the same, only their structures seem more complex.

All this is quite in keeping with what Aristotle says about the origin of atomism in the Eleatic problem of 'what is' and 'what is not' and in the problem of how contraries may be true of some physical object.⁶⁵ 'What is' and 'what is not' may both be true of any given portion of a physical object because one may find both atoms and void there. Further, at Physics 1.5, 188a24ff. Aristotle describes the three basic terms of Democritus--shape, placement, and order--as kinds or genera of contraries: γένη ἐναντίων. And it is quite true of Democritus that he uses these contraries as principles for explaining physical objects (πάναντία πως πάντες ποιοῦσι τὰς ἀρχάς), principles for explaining how it is that such contraries arise; and this attempt is a quite reasonable one (καὶ τοῦτο εὐλόγως). 'What an object is' in atomic terms means no more than giving a reckoning of the atomic shapes that constitute it; it is or is not a specific object (e.g., a man, a pig, a stone, a fire) only because and inasmuch as it has a specified number of various atomic shapes.

But this still does not by itself explain how contraries may be true of the same physical object; we do need to use all three of the basic terms. We have already mentioned how the first of these, shape (as geometrical figure), may explain some contraries. While the size of atoms which predominate in the

⁶⁵For example, Meta. 4.5, 1009a22ff.

mixture determines the essential nature of the πανοπερμία, it may contain any variety of geometrical figures, so that some water may taste bitter and a different portion of that same water may taste sweet, depending on the predominance of a certain geometrical figure in the portion. And these are precisely the kinds of contraries that Aristotle specifies for shape (geometrical figures): σχήματος γεγωνισμένον ἄγωνιον, εὐθὺ περιφερές--Physics 1.5, 188a25-26. And likely all, or at least a large number, of these geometrical figures are mingled in everything. And this seems to be evidently what Aristotle has in mind when he says that Democritus--as well as Anaxagoras--taught that everything was mingled in everything.⁶⁶

But these explain only some of the contraries, and we have not yet taken into account the contraries which may be generated by the other two terms, διαθιγή and τροπή; they too are γένη ἐναντίων. These have no role at all in determining for Democritus 'what a thing is', but only what might be called 'accidental qualities', such as color. With them we must begin to consider the void as well, for they indicate a given placement in the void in some position relative to other atoms; and there is both atoms and void at any given portion of a physical object⁶⁷ to explain contraries in the same ob-

⁶⁶Ibid., a27: μεμῖχθαι πᾶν ἐν παντί φησι καὶ Δημόκριτος. This is mentioned precisely in the context of attempts at explaining the presence of contraries in the same physical object. And this is quite consistent with the teaching about πανοπερμία.

⁶⁷Ibid., a28-29.

ject. Any shift in placement or order engenders only an apparent change; though the object in question may 'look like' a different object, it is structurally, atomically, by nature still the same object, because it still has the same number of specified atoms. When such a shift of placement occurs, other sets of contraries may become true of the same physical object (e.g., it may be blue and then not-blue, soft and then hard).⁶⁸ Thus what for Aristotle would be generation and corruption is explained by Democritus in terms of adding and subtracting atoms; and other changes are due to a shift in the placement of the object's atoms.⁶⁹

All of this, the atomic structure of physical objects and the role of placement and order of the atoms, was quite obviously meant to explain physical objects as we perceive them, to account for change, motion, and multiplicity. Aristotle is quite right in saying that Democritus and Leucippus made their principle or beginning in accord with nature, that they presented accounts which accord with sense-perception, that Democritus was convinced by arguments founded on the study of nature.⁷⁰

And it is precisely on this score that Aristotle criti-

⁶⁸Gen. et Corr. 1.9, 327a18-20; an object becomes solid by τροπή καὶ διαθίγη, according to Democritus; at 1.2, 316a1-2, color is by τροπή. For a fuller account of Democritus' teachings on such differences compare Theophrastus, De Sensibus, in Diels-Kranz 68A135.

⁶⁹Gen. et Corr. 1.8, 325a32-35.

⁷⁰Ibid., 1.8, 325a3, 24; 1.2, 316a14.

cizes the atomic theory of the structure of physical objects: it annuls or abolishes many of the opinions and impressions that we have by sense-impression.⁷¹ Democritus had made a proper beginning in starting with objects as they are perceived and known,⁷² but he was in difficulty about contraries being true of the same object, and he saw no other alternative than to account for these in terms of atoms and void. And this means that for Democritus--for no justifiable reason--the physical object is not at all what we perceive it to be; its unity, its being subject to alteration, its differentia, its persistence while changing--indeed, all that we can really know about it--all of this he must deny about the physical object itself. These, as we shall now see in some detail, are the criticisms which Aristotle levels against this theory of the structure of physical objects.

When we perceive an object, we perceive it as a single, continuous, whole object--a unity. The theory of the atomic structure of things, as we have already pointed out, denies that this is really true of any physical object, whether 'complex' or a 'simple body'. To repeat one example, at On Generation and Corruption 1.9, 327a8ff. Aristotle cites the example of water freezing (or some similar phenomenon): we see that the same object as a continuous whole (συνεχὲς ὅν) is on one

⁷¹Caelo 3.4, 303a22-23: πολλὰ τῶν ἐνδόξων καὶ τῶν φαινόμενων κατὰ τὴν αἰσθησὶν ἀναίρειν.

⁷²See especially Physics 1.1 (e.g., πέφυκε δὲ ἐκ τῶν γνωριμωτέρων ἡμῖν ἡ ὁδὸς καὶ σαφεστέρων).

occasion water, on another occasion ice; Democritus claims that this happens by a shifting of the individual atoms. But this means that the change must be occurring piece-meal, one part at a time, until the 'whole' object is finally changed. But this, Aristotle objects, is contrary to the evidence of the senses,⁷³ for we see the object as a whole on one occasion liquid and then solid: ἅπαν ὑγρόν, ὅτε δὲ σκληρόν καὶ πεπηγός ἐστίν--327a22-23.

And furthermore, the atomic structure of the physical object in conjunction with its dynamic atoms, leaving, coming, and rearranging themselves, leaves no permanent οὐσία for the physical object, no real grounds for continuing to call the object the same thing. And this is the criticism which Aristotle is making against Democritus and others at Metaphysics 4.5, 1009a37: "And furthermore, we shall demand of them that they suppose that there is some other kind of οὐσία which does not have the characteristics of change, corruption, or generation at all."⁷⁴ These men are so intent on explaining the

⁷³Cherniss, op. cit., p. 105, says that Aristotle's criticism is naive, in that he should expect to see invisible atoms at work. But this is to miss the point of Aristotle's criticism.

⁷⁴ἐπὶ δ' ἀξιόσομεν αὐτοὺς ὑπολαμβάνειν καὶ ἄλλην τινὰ οὐσίαν εἶναι τῶν ὄντων ἢ οὔτε κίνησις ὑπάρχει οὔτε φθορὰ οὔτε γένεσις τὸ παράπαν. Philip Merlan, "Hintikka and a Strange Aristotelian Doctrine" in Phronesis, XV, 2 (1970), takes the ἄλλην τινὰ οὐσίαν as 'some other realm of being', that is, as the supralunary world referred to by Aristotle at 1010a25-32. But the major issue which Aristotle is discussing in this chapter (and we ought not lose sight of it) is the problem of change and permanence in the phenomenal world (in connection with the 'law of contradiction'). What seems to be required

contraries in the same object that they lose sight of the aspect of 'the same object'; they need to recognize as well this aspect of permanence about an object. The whole context seems to require this interpretation rather than that of Merlan.⁷⁵

One may summarize the context in which this passage occurs as follows. Democritus and others had noted the appearance of contraries in phenomenal objects and had tried to account for them without violating the 'law of contradiction'. Democritus believed that he had solved the problem by proposing that such contraries are properties only of the phenomenal object; the physical object, on the other hand, is not a unified object, but actually consists of a large number of atoms in various positions in a void; and the contraries in the phenomenal object are due to the contradictories (atoms and void, 'what is' and 'what is not') in any given portion of the phys-

in this passage is the introduction of something permanent about a given physical object, something about the object which remains stable in the midst of accidental change. This permanent aspect of the object would seem to be its essence or form. Merlan himself discusses the possibility of taking *οὐσίᾳ* and *φύσει* in this passage as *εἶδος* or *τὸ τί ἦν εἶναι* (p. 98)--which seems to me to be right; but he prefers to let a subsidiary point introduced later dominate his interpretation of the passage at 1009a37.

⁷⁵Indeed, Democritus did recognize a 'real of being' which--like Aristotle's supralunary world--has only locomotion (of the atoms in the void), though the motion of the atoms does not present the regularity of the motion of the supralunary realm. So evidently this recognition of such a realm of being is not what Aristotle has in mind to demand of Democritus. But the point that Aristotle is making against Democritus and others is that Democritus recognizes nothing permanent and stable about the physical object; the addition or deletion of a single atom makes it a different object.

ical object (1009a22-30). But, Aristotle objects, 'what is' is not limited to the simple and absolute sense of 'what exists'; it can also be used in a particular sense, as 'what is some particular object'; and even the same object can both 'be' and 'not be' at the same time, as long as it is not both actually. For example, the same apple can both 'be red' and 'be not red' at the same time, provided that it is one of these contraries only potentially; it can be both potentially red and actually not red (1009a30-36). But this still does not solve the problem of contraries, for we also need to account for the identity of an object in the midst of change; we need some other *oúōō* of the 'things that are' (i.e., of physical objects) which is not subject to change; and that permanent aspect of a given physical object is its essence (1009a36-38).

Aristotle then goes on to speak about 'truth in appearances', the problem of recognizing and knowing what is permanent about an object (1009a38ff.). The question of the supralunary world is raised in this chapter only at 1010a25-32, and there only to make the point that what may be true in our sublunary world may not be true in another realm, that there may very well be (and evidently is) a realm in which there is no change from one property to another and from one substance to another. The supralunary realm with its regularity belies the undue emphasis on change which Democritus and others had made in reference to the whole universe.

Democritus then is liable to the criticism that, while

all the evidence points to something permanent about physical objects--and we also continue to speak of it as the same object--his theory would reject such permanence. This, Aristotle seems to claim, is due to the fact that no one had yet developed the ability or inclination to distinguish properly the essence of an object from the contraries which may at various times be true of it.⁷⁶ Democritus, Aristotle had said, made some attempt at defining the essence of an object;⁷⁷ and Democritus defined it in terms of a certain proportion of atoms of a particular kind, and he also defined what is hot (this, he said, was due to spherical atoms). Democritus does seem to have made some beginning at distinguishing essence from the contraries, inasmuch as contraries were for the most part due to the geometrical figures of the atoms and their relative positions, while essence was basically specified in terms of the number of atoms of a certain size in that object. This was indeed an attempt, but it still left the 'essence' of an object as something quite variable--and this is contrary to our impression of something more permanent in an object.

Furthermore, Democritus' theory of the atomic structure of physical objects, Aristotle says, neglected potency altogether. A given whole object cannot in principle be something else potentially. For instance, a given volume of water can

⁷⁶Metaphysics 13.4, 1078b25-27, though Democritus seems to have made considerable progress in this direction.

⁷⁷Ibid., 1078b19-20.

not change completely into air (vapor)--a change which quite obviously takes place. This, Aristotle explains,⁷⁸ is because the atomic theory itself of the structure of physical objects forbids it. On atomic principles the generation of a new element must stop short before the 'old' element is completely exhausted: ἀνάγκη δὲ καὶ ὑπολείπειν τὴν ἐξ ἀλλήλων γένεσιν--Caelo 3.7, 305b20. And the reason for the generation stopping short lies in Democritus' own theory of atomic structure; according to him one element (e.g., water) differs from another (e.g., air) in that they each contain a different mixture of atomic sizes--water evidently contains more larger atoms than does air, earth contains more larger atoms than water. Thus when water changes to air or when earth changes to water, there will always be a residue of larger atoms which cannot be accommodated into the new element. Thus the physical object as a whole cannot potentially be some other object.

Democritus had thus neglected potency as a factor in explaining the problem of change. An object, Aristotle claims, may be one thing actually and at the same time be potentially something contrary, or it may be actually qualified in one way and potentially qualified in a contrary way (Meta. 4.5, 1009a34-36). This means that the law of contradiction continues to hold for the physical object as perceived, and Democritus was in error when he felt that it was necessary to posit

⁷⁸Caelo 3.7, 305b20-27.

unperceived atoms, to deny the unity of physical objects, and to annul what sense-perception gives us.

And, beside failing to account for complete generation, the generation which Democritus does describe is no real generation at all; it is only apparent (φαινομένην γένεσιν--Caelo 3.7, 305b3), for nothing new comes into being. The new element is already actually there, present in the old element; and thus the process of generation amounts to nothing more than taking part of the old material out--like taking pieces of something out of a jar or out of a sack full of various pieces.⁷⁹ Cherniss objects that this is not fair, for Aristotle "overlooks the fact that for the Atomists segregation would be only part of the process of which the moment of recombination is at least an equally important part" and that one cannot therefore trust this sort of an account.⁸⁰ But the account of Aristotle is quite fair, for this is the way in which Democritus in his preliminary attempts at definition defined substances, the essential natures of objects; and the 'recomposition' which Cherniss mentions accounts for contraries, for various and changing (secondary) qualities that the object apparently has, and has nothing to do with its essential nature.

With the reduction of all these changes to shifts of atoms, the atomic system reduced all motions to locomotion.

⁷⁹ ὥστερ ἐξ ἀγρείου τῆς γενέσεως οὕσης (305b4-5). One might note the striking similarity to Lucian's description of a πανοπερμύς as a sack filled with all kinds of grain.

⁸⁰ Op. cit., p. 119.

Thus they unnecessarily neglected other kinds of 'motion'--as the alteration of a physical object. And this is the criticism which Aristotle brings against Democritus at Metaphysics 1.4, 985b19, for Democritus, he says, neglected πῶς [κίνησις] ὑπάρξει τοῖς οὖσι--"how motion will be a property of physical objects." This has reference to the kinds of motion other than locomotion, and it is not the same criticism which is leveled at Democritus at On the Heavens 3.2, 300b8-16.⁸¹ Physical objects change at times without there being any apparent locomotion; and Democritus might have accounted for this change without resorting to a non-apparent locomotion. It was thus unnecessary and unwarranted to assume an atomic structure for physical objects and to assume that all change was a change of place--assumptions which in effect do away with empirical evidence.

Democritus had evidently been impressed by the unusually large number of differences in various phenomenal objects, and, in order to account for this vast variety in phenomena, he had claimed that there was an indeterminately large number of 'simple bodies'. But this, Aristotle says, is where he and others are in error,⁸² for an unlimited number of such principles ('elements') is not necessary. Democritus could just

⁸¹As Cherniss, op. cit., p. 171, note 120, claims. In the passage in On the Heavens locomotion seems to be assumed, and the kinds of motion there in question are 'forced' and 'natural' motions.

⁸²Caelo 3.4, 303a17-18: ταῦτόν ἀμάρτημα τὸ μὴ πεπερασμένος λαβεῖν τὰς ἀρχάς.

as well have posited a limited number of such 'elements' without any real inconsistency with the rest of his theory.

Secondly, beside it being unnecessary to make the number of elements unlimited, Democritus' reasons for doing so are totally unwarranted if the specific differences are not unlimited in number (Caelo 3.4, 303a19-20). But the atomists can not claim that either the differences in atoms or the differences in the phenomenal world are infinite. Atoms differ from one another in shape; but shapes can be reduced to a limited number of simple shapes (303a32-b2), and thus the kinds of atomic shapes will be limited too.⁸³

And, further, the differences in the phenomenal world are limited too.⁸⁴ And, just as a large variety of atomic shapes can be successfully reduced by analysis to a comparative few, this is true as well of the phenomenal world and the large variety of changes and differences that occur there. Those phenomenal differences can also be successfully reduced to a comparatively small number; and when these changes or differences are reduced to the simplest level, these will be

⁸³ Aristotle seems to put this criticism in a way which is likely extreme, for he claims that on these grounds the atomic elemental shapes ought to be one or two or more. But whether all shapes can be so reduced or not, the criticism that the number will be limited is quite reasonable and proper.

⁸⁴ 303b3-8. The question of qualitative differences was introduced by Aristotle at 302b33ff. (even though Elders, op. cit., p. 19, says that only locomotion is dealt with in On the Heavens), and this is precisely the question that leads immediately to consideration of the atomists' theory of an unlimited number of 'elements'.

changes or differences which are elemental.⁸⁵ These types of change are limited because there can be only two directions of change (up and down, when applied to locomotion; toward or away from some point of reference--hotter or colder--when other changes are in question), and the number of places is limited as well (as points or degrees of change between contraries).⁸⁶ Thus the differences in physical objects cannot, as Democritus assumed, be limitless, either when considered from the point of view of the atoms or from the point of view

⁸⁵Most commentators assume that this passage (303b4-8) deals exclusively with the question of locomotion. Cherniss, op. cit., p. 7, might be cited as an example; and he rightly sees that an argument by Aristotle only in terms of locomotion would be naive and would not affect Democritus' position. Such an interpretation would have Aristotle argue thus: there are only two directions of locomotion (up and down; see Simplicius, de Caelo, p. 615, lines 4-6) and a finite number of places; therefore the number of directions of locomotion are not infinite. This would indeed seem to be naive, for it has Aristotle argue from two simple motions to a finite number of motions.

But $\kappa\acute{\iota}\nu\eta\sigma\iota\varsigma$ here evidently does not refer only to locomotion; Guthrie, de Caelo, p. 293, translates this as 'motion', which is properly vague. $\kappa\acute{\iota}\nu\eta\sigma\iota\varsigma$ refers to qualitative change as well as to change of place (see Physics 3.1, 201a9-16) and might better be simply translated as 'change'. Phenomenal changes seem to be numerous, but Aristotle claims that they can thus be reduced by analysis to a comparatively small number. I would translate the passage here as follows:

"And furthermore, if, in the first place, each element has its own type of change, and the change of such a simple body is simple, and if, in the second place, these simple changes are not limitless (because there are no more than two simple directions of change and a finite number of degrees of change), thus the elements would not even so be limitless in number."

⁸⁶Aristotle at On Sensation 6, 445b24-33 makes the same point as he does here, that there are only a limited number of degrees of differences between two contraries. Stocks, as cited by Guthrie, de Caelo, p. 290, and Elders, op. cit., p. 300, had rightly referred to this parallel idea.

of phenomena.

Furthermore, the elements could not be limitless in number, Aristotle points out, because of the very meaning of 'what is limitless'. If they are 'limitless', then there could be no exact knowledge of 'what is': οὐχ οἶόν τε . . . ἀπείρους δ', ὅτι οὐκ ἐπιστητὸν τὸ ὄν ἔσται. --Physics 1.6, 189a12-13. Indeed, such a limitless number is, besides, highly suspect, because it always remains potential; it never becomes an actual number because one can always think toward a higher number: ἐπὶ δὲ τὸ πλεῖον ἀεὶ ἔστι νοῆσαι . . . ὥστε δυνάμει μὲν ἔστιν, ἐνεργείῃ δ' οὐ --Physics 3.7, 207b10-12. The number can by definition never be attained. The infinite then is in principle beyond our experience and impossible to grasp, and cannot thus be used as a principle to explain things.

Democritus' atomism had also forced him, Aristotle says at On Generation and Corruption 1.7, to a one-sided, limited view of action and passion. For Democritus atoms and void are complete contraries; atoms cannot in principle affect the void, nor can void in any way affect the atoms. The only things in Democritus' atomic system which can either produce an effect or be affected are the atoms themselves; and they can act or be acted upon only inasmuch as they possess the common property of body; and atoms and void cannot in principle affect one another, for they have nothing in common (1.7, 323b11-15). Thus, Aristotle says later, Democritus belonged to that group

of thinkers who "with a view to matter thought that agent and patient must have some identical property."⁸⁷

But this view, Aristotle contends, is too limited, for it takes no account of contraries affecting one another--as, for instance, 'that which is hot' heating that which is cold or that which is one color coloring something of another color or that which is bitter making something else bitter. And these are precisely the kinds of effects that are given in empirical evidence. Democritus had only considered the sameness of agent and patient, but had neglected the difference between them. And an account of both the sameness and the difference between objects which affect one another is necessary for a complete explanation.

Furthermore, since these contrary properties and effects of physical objects can be explained without resorting to an atomism of which we have no real evidence, Democritus' teaching in this matter is unnecessary and unwarranted.

For the most part this is what Aristotle's criticism of Democritus' explanation of the structure of physical objects amounts to. Democritus was unduly influenced by Eleatic arguments on the meaning of 'what is' and 'what is not'; but he also--like Anaxagoras--felt that he must give account of phenomena. But phenomena provided the problem of explaining contraries in the same object. These contraries, combined with

⁸⁷Gen. et Corr., 1.7, 324a23-24: οἱ μὲν οὖν εἰς ἐκεῖνον [i.e., τὴν ὕλην] βλέψαντες ταύτόν τι δεῖν ῥηθῆσαν τὸ ποιοῦν ἔχειν καὶ τὸ πάσχον.

a limited Eleatic meaning of 'what is', seemed to Democritus to eliminate the possibility of explaining objects and their properties adequately on the phenomenal level and to necessitate an explanation on a sub-phenomenal, atomic level. But Aristotle has consistently and in various ways pointed out that this 'leap' to a non-empirical level was not necessary. Its only apparent necessity rests on a mistaken notion of the meaning of 'what is'; one need not resort to an atomic structure, because objects and their properties are quite intelligible without it.

Once Democritus had begun his explanation on the atomic level, he was quite consistent in applying its various consequences. Aristotle praises him for his consistent method: ἐν τῷ πῶς διαφέρει ("he excells in his method of explanation" --Gen. et Corr., 1.2, 315b1); περὶ πάντων ἐνὶ λόγῳ διαρίχασι ("they have made distinctions about everything in a single account" --Gen. et Corr., 1.8, 325a1). But, in spite of this admirable consistency, Democritus' system, Aristotle claims, itself breaks down when one tries to apply it.

We have already touched on some of the aspects of the break-down of this system of atomic structure. And one of the most obvious examples already cited is that of the attempt of Democritus to account for the mutual generation of the elements. In On the Heavens 3.4, 303a25-29 Aristotle points out how the system itself contains an internal contradiction. Democritus had claimed that this generation of one element from

another takes place by the separation out of the largest atoms; but, Aristotle replies, since every element must contain all the variety of sizes for mutual generation, the process of separation out of the largest atoms will on each occasion bring about either a lack of smaller atoms in the new element or a lack of larger atoms in the old element.⁸⁸ Under the specified conditions such a mutual generation can in fact not take place.

To stay for a moment with the criticisms presented in On the Heavens,⁸⁹ Aristotle says that Democritus' system is further not adequate, because it only accounts for the dividing or destroying function of fire; it neglects and, indeed, must fail to account for fire's capacity to unite things. The sphere was assigned as a specific shape to fire precisely because of its power to penetrate and break things up. But fire obviously unites and welds things of the same kind; indeed, this to Aristotle is an even more essential function than that of separating: καὶ ἡ μὲν σύγκρισις καθ' αὐτό ἐστι . . . ἡ δὲ διάκρισις κατὰ συμβεβηκός--3.8, 307b4-5. At the very least then Democritus ought to have assigned a shape to fire which would be consistent with both functions: πρὸς ἄμφω ἐχρήν

⁸⁸ ὑπολείψει γὰρ δὲ τὰ μέγιστα--Caelo 3.4, 303a27. If the 'new element' is the residue left after the largest are separated out, the 'new element' will lack the largest atoms and thus not be an element capable of generating others; if the 'new element' is to be composed of the largest atoms separated out, it will lack the smaller atoms. Thus in both cases the new element is not an element at all; it will lack the requisite variety of sizes for mutual generation.

⁸⁹ 3.8, 307a32-b6.

ἀποδοῦναι--307b4-5. Thus there is again a serious defect in this system.

Again, in the same chapter, several lines later,⁹⁰ since hot and cold are contraries, Aristotle points out, in the same category of temperature, and since Democritus had assigned a shape to what is hot, he ought logically have assigned a contrary shape to what is cold. But he could not and wisely did not, for there are no contraries in shapes. Aristotle repeats precisely this criticism in On Generation and Corruption 1.8, 326a3-6 in connection with a more elaborate analysis of the logical consequences of Democritus' version of atomism. And it is now to this latter passage as a whole (1.8, 325b33-326b6) that we turn our attention.

It is often claimed on the basis of this detailed analysis of atomism that Aristotle mistakenly claimed that for Democritus the spherical atom was hot.⁹¹ But Aristotle is quite careful about his language. He had just been discussing the matter of the atoms not being hard, and says: οὔτε σκληρὸν οἶόν τ' εἶναι (326a3--"nor can it be hard"); and a few lines further on he makes mention of heat and cold as examples of

⁹⁰307b7-10.

⁹¹For example, Cherniss, op. cit., p. 97, note 409: "Democritus, evidently, did not believe that he was assigning a quality to the spherical atom . . . and the resulting quality amounts almost to making the quality primary." Cherniss goes on to argue that Aristotle feels it established that for Democritus the atom itself has the quality of heat as a property of it. Likewise also Verdenius and Waszink, op. cit., pp. 42-43. But this is premature; that is not established until later in the logical analysis.

qualities in sets of contraries as possible properties of atoms: εἰ ταῦτα μὲν ὑπάρχει (326a7--"if these are properties"). But in the passage primarily in question Aristotle speaks quite carefully about referring what is hot to the sphere: ἀποδοῦναι τῷ περιφερεῖ σχήματι τὸ θερμόν --326a4-5. Aristotle does not say that for Democritus the spherical atom was hot, though this may very well have been deduced as a logical consequence of the theory.

I believe that it is important to recognize that we have at 326a4-6 and at 326a7-14 two separate criticisms, each of which traces a separate consequence of Democritus' system, each introduced by the criticism, ἄτομον --"it is paradoxical."⁹²

In the first criticism at 326a4-6, what Aristotle considers as paradoxical or illogical is to assign a shape to what is hot, but none to what is cold, its contrary.⁹³ We have already seen that Democritus did not attempt to do so, and wisely, Aristotle thought, because there are no contraries in shapes. But it is nevertheless quite right that it makes no sense to assign a shape to hot but none to cold; they are quite obviously degrees in the same category.

But it is the second criticism at 326a7-14 that is the

⁹²This term is found at both a4 and a7; the next criticism as well is introduced in this way at 326a15.

⁹³If the atom itself were hot, the first illogical consideration would certainly have been that Democritus makes some qualitless atoms have a quality such as heat; but that is not the case here.

subject of some controversy. The interpretations vary in the first place on the issue of whether the atoms themselves have weight and how that weight varies.⁹⁴ A second point of variance is on Aristotle's argument itself, the question of how Aristotle can deduce logically atoms that are affectable from the concept of an atom which is ἀπαθές (326a1).⁹⁵ Let us then follow the argument and see how Aristotle can logically come to the conclusion that the atoms must be capable of being affected. We begin again with atoms which are incapable of being affected and use in the argument nothing but what is explicitly attributable to Democritus and its reasonable consequences.

Aristotle's first and major point is that it is unreasonable for atoms to have a quality in one set of contrary properties, but none in other sets--or, if we may put it that way, there is no real difference between the sets of primary

⁹⁴Cherniss, op. cit., p. 97, note 412, concludes that "each and every atom has relative weight when compared (with any other);" Verdenius and Waszink, op. cit., p. 42, rightly retain the relationship of size to weight; see my previous discussion of the question of weight in chapter two.

⁹⁵Cherniss, op. cit., p. 99, says that atoms yield to pressure because of their 'hardness', and being hard implies some degree of softness and thus "the inconsistency here developed in the Atomistic theory is due to the implications of Aristotle's technical terminology." Verdenius and Waszink, op. cit., p. 43, see the reason as being the fact that the atoms themselves have temperature and thus can interact. This may be indirectly so, but it seems to me to miss the point of the argument, which hinges on the first sentence in this passage (326a7-8), and not so much on the previous argument, which did not establish that the atoms are hot or cold--in which case Aristotle would not have needed the point he raises at 326a7-8.

and those of secondary qualities. If atoms have one set, they can reasonably be expected to have the other sets as well (326a7-8). And yet Democritus does claim that they have qualities in one set of contraries in that their weights vary; thus they evidently have other sets, and one atom must therefore be hotter than another (326a8-11).⁹⁶ But, if this is so, they must also be affected by one another, for they must then also have the set of contraries softness and hardness; and, if softness, then affectability (326a11-14). I would thus translate the passage as follows:

"And it would also be strange if atoms have these sets of contraries (which I mentioned in the first argument) --I mean heat and cold--while other sets (heaviness and lightness, hardness and softness) are not going to belong to them. Now Democritus does say at least that each atom has a weight in proportion to its size; and so (with one set of contraries as inherent properties established) the others must also be, and so evidently the atoms must have heat in varying degrees. But, since they are such (qualified by these different sets of contraries), they cannot help but be affected by one another, for example, the slightly hot atom will be affected by one whose heat far exceeds it. Nay rather (being affected will be their very nature with these sets of contraries as inherent properties, for) if one atom is (relatively) hard, it will also be relatively soft; and now what is soft already contains the meaning of suffering some effect, for what yields to some force is soft."

⁹⁶It is first here, as a logical consequence of having weight, that atoms also ought to have heat; this point further establishes the fact that logically that heat ought to vary in degrees among various atoms, just as the weight varies. Cherniss, op. cit., p. 98, note 413, and Verdenius and Waszink, op. cit., p. 42, rightly reject Joachim's contention of a specific reference to spherical atoms. It is not necessary to bring in here, with Cherniss, the point made at Caelo 3.8, 307a13-18 that the degree of heat ought to vary as the shape approaches that of a sphere; the arguments are only parallel in that they are both concerned with varying degrees of heat..

Thus it is not the technical meaning for Aristotle of the word *σκληρόν* which allowed the affectability of the atoms, but the fact that hardness and softness are qualities in a set of contraries, and the admission of qualities in one set of contraries as properties of atoms reasonably allowed the admission of other sets, there being no reason for admitting one set and refusing others.

The third argument, at 326a15-25,⁹⁷ presents a triple paradox, with all three of the elements of the paradox together exhausting the possibilities of ascribing properties to the atoms. It is strange and paradoxical: 1)--326a15-16--if the only property that an atom has is shape (and this, as will become more evident, is Democritus' basic position);⁹⁸ and 2)--326a16-18--if an atom did have some other quality like hardness or heat,⁹⁹ (for then all atoms would not have the same nature: οὐδὲ γὰρ ἂν μία τις εἴη ἡ φύσις αὐτῶν --326a17); and

⁹⁷Verdenius and Waszink, *op. cit.*, p. 44, divide this into two distinct objections to atomism; they had also combined into one those which I refer to as the first and the second objections; I prefer to follow the divisions which Aristotle himself made by introducing each with *ἄτομον*.

⁹⁸Aristotle does not raise any specific objection to this; likely the objection is taken to be self-evident, either on the grounds that Democritus himself felt uncomfortable with so bald a statement and indeed did ascribe weight as well to atoms, or, more likely, on the general grounds that such a physical object, though atom-sized, would without any other qualities not seem to be a physical object at all, but a totally abstract concept, like 'circle'.

⁹⁹With Verdenius and Waszink, *op. cit.*, p. 43, who prefer the reading of the text to the suggestion of Joachim and Forster to read *ψυχρόν* in place of *σκληρόν*.

3)--326a18-25--if any one atom had more than one of these qualities as properties, then, since atoms are indivisible, they would have these properties in the same place (ἐν τῷ αὐτῷ--326a19); and, if it was affected in one quality, it would need to be simultaneously affected in all its qualities as a whole, for without any void in atoms they could not vary in density and so be more or less affected at one place in one quality rather than at another place; as indivisible they must be affected as a whole in all respects. Thus both the attribution of some property--one or more--to atoms and the failure to attribute any property to them is paradoxical.

There seems to be no problem of interpretation of Aristotle's fourth argument at 326a25-29; Democritus seems to have made size a criterion of indivisibility.¹⁰⁰ But, Aristotle objects, there is no good reason for making only small objects indivisible.

Aristotle's next objection to the atomism of Democritus (326a29-b2)¹⁰¹ is raised in connection with the disjunction: either the nature of all the solids is identical or some of the atoms are of a different nature than others: μία πάντων ἢ

¹⁰⁰This would seem to me to cast into doubt the teaching attributed to Democritus that there might be atoms of extremely large size, a teaching which is referred to in Aetius, *Placita* 1.12.6; see Hermann Diels, *Doxographi Graeci* (Reprinted in Berlin: Walter de Gruyter and Associates, 1958), p. 311, lines 21-22. It seems likely that this attribution of the teaching was due to the criticism of Aristotle in this passage.

¹⁰¹Aristotle has now stopped using ἄτομον to introduce his new sets of criticisms.

φύσις ἐκείνων τῶν στερεῶν ἢ διαφέρει θάτερα τῶν ἑτέρων;
 (326a30-31). With the one alternative--if their nature is one and the same--there is no logical reason then for their staying separate and distinct parts: τί τὸ χωρίσων; (326a33). On the other hand, if the atoms are different in nature--e.g., one group with fire-like qualities, another with earth-like qualities (τὰ μὲν εἴη πύρινα, τὰ δὲ γήινα--326a32)--then these sub-groups of atoms will be the true basic constituents of things; they will be the principles and reasons for the things that come from them. In either case the atoms cannot remain atomic; they will either merge and lose their identity or they are not themselves as such the most basic unit.

Furthermore (326b2-7), if they are different in nature (with their differences describable either in terms of sets of contraries--as in the second criticism at 326a7-14--or more briefly--as at 326a32 as 'earthy', 'fiery' and such) then they mutually affect one another on contact.¹⁰² But this also raises the question of what it is that brings about this change. If it is the other atoms, then atoms can be affected by something else. If it is the atom itself which is undergo-

¹⁰²Cherniss, *op. cit.*, p. 101, note 422, claims that Aristotle here disregards the attempt to distinguish mechanical interaction and qualitative alteration. But if the atoms have qualitative differences--e.g., 'softness' and 'hardness', as above, or the 'fluidity' of water--they will certainly be affectable on contact. If one allows these qualitative differences as real differences between atoms, one must allow as well for qualitative alteration.

Cherniss is here right in rejecting Joachim's claim that Leucippus taught the mutual affectability of atoms.

ing the change that brings about the change, then, either the atoms will be divided with one part causing the change and the other part undergoing the change, or--with contraries present in the same atom¹⁰³--the atoms will have a material base which is numerically one and only potentially one, not a real unity. Thus Democritus would in this case have to admit that such atoms different in nature are either capable of being affected or are not the solid and permanent units which he had supposed they were.

Such are the reasonable consequences of Democritus' atomism; it cannot be held consistently without opposing strenuous objections; the consequences of this logical analysis lead to a more unified matter (326a33), elements with qualities (326a32) and divisibility (326a25-29)--all striking at the very roots of atomism.

The Soul

From Democritus' view of the atomic structure of physical objects and Aristotle's criticism of it we now proceed to consider Democritus' teaching about the soul. For Democritus 'soul' meant that which is uniquely capable of producing motion in the animate body and is as well extremely sensitive to motion. The production of motion in the animate body was evi-

¹⁰³We must remember that the one major thing that Democritus was trying to avoid in positing his theory of the atomic structure of physical objects was the difficulty posed by the presence of contraries in the same object.

dently the primary consideration.¹⁰⁴ Democritus belongs to that group which claimed that the principle characteristic of the soul was to set things in motion: καὶ πρῶτως ψυχὴν εἶναι τὸ κινεῖν--Anima 1.2, 403b29. This group was further convinced that the only thing which would produce motion was something which itself was in motion (403b30).¹⁰⁵ It was on the basis of this consideration that Democritus arrived at his theory of the nature of the soul (404a1-3).

Soul, Democritus said, consisted of spherical atoms, because these cannot really stop moving--it is indeed their very nature to be in motion¹⁰⁶--and because of their being very sensitive to motion (Anima 1.2, 405a11-12), and because of their ability to set others into motion (404a8). Thus, what made soul what it is for Democritus, that which was the one really essential ingredient, was the spherical atom. This meant quite rightly that what made the soul soul was the same thing that made fire fire, spherical atoms which have the effect on us of 'heat': "the soul is some sort of fire and is warm"--πῦρ τι καὶ θερμόν φησιν αὐτὴν εἶναι --404a1. Aristotle nowhere assumes that the spherical atom for Democritus is hot

¹⁰⁴Anima 1.2, 404a8-9: ὑπολαμβάνοντες τὴν ψυχὴν εἶναι τὸ παρέχον τοῖς ζῴοις τὴν κίνησιν. Cherniss, op. cit., p. 290, is right in maintaining that the atomist view of the soul was not formulated primarily to account for the warmth of the living body.

¹⁰⁵This was quite necessary with Democritus' reduction of all motion to what is purely mechanical locomotion; compare Anima 1.3, 406b16-21.

¹⁰⁶Anima 1.3, 406b21.

or that Democritus taught the complete identity of soul and fire,¹⁰⁷ but only that they had the same essential ingredients and some similar functions. It is furthermore not unlikely that Democritus himself was quite aware of this similarity and may very well have used it to account for the warmth of the body.¹⁰⁸

But 'soul' for Democritus does not exist in isolation from the body any more than the spherical atoms in the air function as fire. Fire is only fire when it is burning something, when penetrating some object and setting its constituent atoms into violent motion and breaking up. So soul is only soul when it is functioning as part of an animate body, for spherical atoms are likely to be found anywhere in the universe without their there necessarily constituting what we would strictly speaking call 'soul'. They are in the air, in fires, in water, and likely in other objects as well; and they quite apparently do not function as 'soul' in such combinations.

But there is no further statement that really specifies at what point a group of spherical atoms really become 'soul'. They are present in and explain the movement of 'motes in the air' (Anima 1.2, 404a3-4); they are intermixed in the body with other 'body-atoms', apparently are in the various sense-organs in various kinds of mixtures; they are, for example, in the aqueous nature of the eye and there are likely sensitive to

¹⁰⁷As Cherniss, op. cit., p. 289, claims.

¹⁰⁸Compare Guthrie, History, II, 432.

visual images.¹⁰⁹ And it is quite likely that the particular formula for the mixture and arrangement with 'body-atoms' was intended to vary somewhat with the nature of the object or of the organ in question; but no real formula for mixture seems to have been specified.¹¹⁰

It is likely that the high degree of mobility and the penetrating power of the spherical atoms, while perhaps more appropriate to the characteristics of fire, provided some difficulty in the body, for they would be very likely to escape. There is at both On Respiration 4 and at On the Soul 1.2 an account by Aristotle of Democritus' attempt to integrate this into his systematic explanation of the soul.¹¹¹ Soul atoms are constantly escaping from the body due both to their own penetrating ability and to pressure from the air surrounding the body; but the supply of soul-atoms is maintained by breathing, which brings in with the air the spherical atoms contained in the air. And this renewed supply restores the balance between the pressure from the outside and the counter-pressure from within. Thus the animate body requires a certain proportion of spherical atoms not only for motion, but also for life itself; and it is only through breathing that this dynamic equilibrium is maintained.

¹⁰⁹Sensu 2, 438a6-8.

¹¹⁰Lucretius De Rerum Natura 3.372-373, gives a more general account in saying that they simply alternate with the body-atoms.

¹¹¹The fuller account, followed here, is at Respir. 4.

If we may come to any conclusions about Democritus' teaching of the soul from this account, it is likely to be this, that no spherical atom by itself or in any random intensity (i.e., a specific number of spherical atoms per specific volume) is likely to be soul any more than it is likely to be fire. For there to be fire the intensity of spherical atoms is likely to be very great--as witnessed by the great heat of fire--whereas the intensity of spherical atoms as soul in the body (that is, the proportion of spheres there) is likely to be less. Apart from that, the constituents of both fire and soul might well be the same. 'Soul' then is to be explained as a specific (though unspecified) proportion of spherical atoms in a body, sufficient to produce motion and offset the external pressure on the body, and yet not great enough to break up the body (which is evidently what 'fire' would do).

And now, as Aristotle begins his criticism of Democritus and others like him who say that soul produces movement by itself being in motion, his first concern is to show that this sort of an account is not necessary--and, indeed, may be impossible--namely, that the soul have motion as an essential property: ἔν τι τῶν ἀδυνάτων τὸ ὑπάρχειν αὐτῇ κίνησιν --Anima 1.3, 406a3. First of all, Democritus had claimed that the producer of motion needed to be in motion. But this is not at all necessary; that one thing can cause motion in another without itself being in motion is not an impossible notion (406a3-4). Secondly, an object may be in motion only indirectly, as the

passengers in a ship; the ship is directly in motion in the water, but the passengers are only in motion inasmuch as the ship is. Thus, even though the soul may indeed be in motion, it may be so only indirectly and in a way not essential to it or to its operations (406a4-12). Thirdly, its movement need not be locomotion, as Democritus specified, for there are other kinds of movement: alteration, decrease, and increase (406a12-14). Thus Aristotle legitimately concludes that it is certainly not necessary for the soul to be essentially in locomotion, even if it produces this in the body; its effects can be explained without recourse to the soul's being in locomotion as an essential part of its operation. Democritus' conclusion was thus not justified (Anima 1.2, 403a29-31); and here at the very foundation of Democritus' atomistic explanation is where the error lies.

Furthermore, Aristotle claims, such a mechanistic explanation of the action of the soul, aside from appearing more characteristic of the lines one hears in a good comedy (Anima 1.3, 406b15-20), has presented only one side of the picture of the soul, for such a theory will find it hard--if not utterly impossible--to have the ever-active soul-atoms account for the body's coming to rest. The same atoms whose nature it is never to stand still (πεφύκεναι μηδέποτε μένειν--406b21) can not cause rest (ἡρέμηναι ποιεῖ--406b23). Such a limited view of the soul and its functions cannot be adequate.

Beside the fact that the soul and its motion are not ad-

equately explained in this account, there remains the defect that Democritus' theory of breathing, which is intimately connected with the soul and its operation, is weak as well. In the first place, it totally neglects one obvious purpose of breathing--to cool oneself. For we breathe, Aristotle says, more heavily the hotter we get, whereas in cool weather we tend to check our breath and breathe less (Respir. 4, 472a31-35). Thus, Aristotle concludes, we obviously breathe in order to cool ourselves;¹¹² but, according to Democritus' explanation, breathing would have the opposite effect--to bring in more spherical atoms which produce the sensation of heat, that is, to make us feel hotter, when we are already too hot in the first place: ὡς ἀναψύξεως χάριν ἀναπνέοντες, ὅτε τὸ λεγόμενον ποιεῖ πῦρ ἐπὶ πῦρ --472b4-6.

Secondly, such an account of the soul and of breathing admits at least in principle the possibility of resurrection of dead (Anima 1.3, 406a31-b5). With the ability of the soul at least in part to enter and leave the body, there is no reason why it may not do this as a whole and thus allow for the dead to come back to life again: τοῦτω δ' ἔποιτ' ἂν τὸ ἀνίστασθαι τὰ τεθνεῶτα τῶν ζῶν (406b4-5); and such resurrection is contrary to the evidence which is available.

Then again Democritus claims that breathing is the mark

¹¹² Thus Democritus is criticized here for neglecting the 'final cause'; his neglect of this as a factor in explanation generated many mistakes, according to Aristotle. This matter will be taken up in more detail in the next chapter.

of animate life (Respir. 4, 472a11-12). But Aristotle says that not even this is a valid claim, for not all animals breathe (μὴ πάντα τὰ ζῷα ἀναπνεῖν--472a28), and hence this cannot be a real mark of animate life. Here at least Democritus was consistent, for he claims as well that they all do indeed breathe (ὡς πάντων ἀναπνεύοντων--Respir. 2, 470b31). But Aristotle replies to this by showing that fish, obviously animate creatures, do not and cannot breathe in any way really identical to the way in which all other animate creatures do, by taking in air by alternately inhaling and exhaling (Respir. 2-3). Fish are thus unique and what they do is distinct enough that we have good reason not to call it 'breathing'; at any rate they do not breathe in the way in which Democritus had described breathing.

There is a further criticism by Aristotle at On the Soul 1.5, 411a8-16 which affects Democritus' position, though Democritus himself is not mentioned. If the universe in general and fire and air specifically have soul (that is, spherical atoms) in them, then logically the air or fire or the universe ought to be a living creature: διὰ τίνα γὰρ αἰτίαν ἐν μὲν τῷ ἄερι ἢ τῷ πυρὶ οὖσα ἡ ψυχὴ οὐ ποιεῖ ζῷον; --411a9-10. Lines eleven through thirteen seem to be peculiarly appropriate to Democritus in view of his connecting the soul so closely with air and breathing: "For one might ask why the soul in air is better and more deathless than that in living creatures." Democritus (and others) are caught on the horns of a dilemma:

it is unreasonable to call fire or air an animal, and unreasonable as well not to call them that if there is 'soul' in them. This criticism assumes, inasmuch as it applies to Democritus, that Democritus did not specify any real distinction between fire and soul--and Aristotle says precisely this very frequently--in terms of the amount of spherical atoms it took to make fire instead of soul. Thus, as far as we can determine, the criticism is justified, for we have no information either in Aristotle or in any other part of later tradition as to whether or how Democritus made this distinction clear. It is reasonable to assume that he did not; he was likely satisfied with a vague and general principle of greater or less intensity of spherical atoms to distinguish soul from either fire or air.

Finally, such a theory of the soul negates a series of obvious unities. First of all (Anima 1.5, 409a31-b4), the ensouled body is a unity. But Democritus claims that the body is moved by the soul and is thus distinct and separate from it; he claims furthermore that the soul is scattered throughout the percipient body: ἐν παντὶ τῷ αἰσθανομένῳ σώματι -- 409b2. If soul, Aristotle replies, is a 'body'--even in Democritus' sense, though not itself a unity--then there must be two bodies in the same place (409b3), the soul-group and the body-group of atoms. Secondly, there seems to be in this passage a further implication that, since soul itself is like any other body or physical object, it itself will not be a unified

thing. And last, but not least, Aristotle says in an earlier passage (Anima 1.4, 409a10-15), even the soul-atom itself; inasmuch as it both causes motion and is moved, will be divided and then endlessly sub-divided, one part moving and the other part being moved, as is the case with anything continuous (ὡςπερ ἐν τῷ συνεχεῖ--409a14), anything which is a quantity quite apart from how big it is: οὐ γὰρ διὰ τὸ μέγεθος διαφέρειν ἢ μικρότητι συμβαίνει τὸ λεχθέν, ἀλλ' ὅτι ποσόν -- 409a14-15.

Thus, in general, Aristotle claims that Democritus' theory of the soul is not an adequate one: it was based on the mistaken notion that the soul puts the body into locomotion inasmuch as it has that same kind of motion itself; it fails to recognize the purpose and scope of breathing; it neglects specifying the distinction between soul and fire and between soul and air; it fails to make an ensouled body or the soul itself a single, unified object.

Sense-perception

Democritus' theory of sense-perception¹¹³ is to be close-

¹¹³Langerbeck, op. cit., pp. 100-112, is convinced that there is no developed theory in what we have of Democritus (p. 112); it arose as Aristotle and Theophrastus examined the implications of atomism for such a theory. In order to arrive at this position he must assume that Aristotle is in effect simply combating a theory that was not held in order to confirm his own theory; and he unnecessarily weakens the meaning of 'true' and 'truth' to 'distinct' and 'distinctness' (see Helene Weiss, "Democritus' Theory of Cognition" in Classical Quarterly, XXXII (1938), p. 48). This seems a totally unwarranted assumption, as I expect to show that what Aristotle says of Democritus does reveal a consistent theory.

ly connected with his positing of what come to be known as εἴδωλα.¹¹⁴ Aristotle himself says very little about these atomic εἴδωλα; he rather focuses his attention on the fact that because of them all perception is reduced to contact. The εἴδωλα are assumed; and those εἴδωλα provide that contact between the perceiver and the physical object; they make it possible for atomic formations of the physical object to have an effect on the 'soul' of the sense-organ. To this extent Langerbeck may be right in saying that Democritus' theory of sense-perception was not a highly developed one, in that, as far as we know, explicit details of the theory were not worked out; but to suppose with him that most of what little we do have about the theory in Aristotle and Theophrastus is their reconstruction of what Democritus' theory would have been if he had developed one is going a bit too far! At any rate, that there were εἴδωλα coming from the physical object and affecting the senses and causing sensations can hardly be in doubt and is generally accepted.¹¹⁵

¹¹⁴More likely Democritus' term was δεικνέλον (see Diels-Kranz 68B123), which is likely broader and referred to an image as something more than seen or visual; see also Beare, op. cit., p. 29, note 3. It likely indicated something more like a 'representation of the physical object' (von Fritz, op. cit., p. 23, speaks of an "Abbild der Struktur der Gegenstände selbst.")

¹¹⁵Compare Guthrie, History, II, 438ff. Langerbeck, op. cit., pp. 52-54, argues that the εἴδωλα are to be connected only with religious experiences: "während für sie die Imagines nur die Funktion einer Übermittlung vom transzendenten Gott zum menschlichen Erkenntnisvermögen haben." But it does not follow from the fact that the atomists used εἴδωλα to explain religious experiences that this was their only function.

If sense-perception is to have any meaning at all in the atomic system, there must be some sort of effect of the physical object on the percipient, either direct or indirect.

This is not to attribute to Democritus any sort of advanced notion of action and passion in Aristotle's sense.¹¹⁶ But for Democritus what 'action' and 'passion' there was was on the principle of 'like to like': Δημόκριτος . . . φησὶ γὰρ τὸ αὐτὸ καὶ ὁμοίον εἶναι τό τε ποιοῦν καὶ τὸ πάσχον.¹¹⁷ One atom could only affect or be affected by another atom, and the only kind of effect that the atom might have on another is to change its direction of locomotion or its position. So the effect involved in sense-perception must be the effect produced by the atoms of the physical object, directly or indirectly, on the atoms of the percipient's sense-organs.

We might first of all take a look at the effects produced by individual atoms which, though unnoticed because of their smallness, still do apparently produce an effect on the percipient. We have already noted that the effect of the spherical atom is the sensation of heat.¹¹⁸ Now this is a general principle which Democritus followed through in regard

¹¹⁶See Langerbeck, op. cit., p. 102, "Der Einwand des Aristoteles ist für jeden, der das αἰσθάνεσθαι als ein πάσχειν erkannt hat, völlig überzeugend." The only real alternative to making sensation an effect of the physical object is to make it an effect of something incorporeal, and this would be totally inappropriate to Democritus' system.

¹¹⁷Gen. et Corr. 1.7, 323b10-12.

¹¹⁸For example, Anima 1.2, 404a1, 405a12-13; Gen. et Corr. 1.8, 326a4-5; Caelo 3.4, 303a13.

to some other sensations of qualities as well. For instance, Aristotle claims at On Sensation 4, 442b10-13: "But these men refer 'specialized properties' to these (common properties of shape and size), just as Democritus does, for he says that what is white and what is black are (due to) what is smooth and what is rough, respectively, and he refers the flavors to the shapes of atoms."¹¹⁹ The various geometrical figures and sizes have certain consistent effects on us. This seems to be more specifically the case with flavors, where Theophrastus assigns a list of flavors to specific shapes (On the Senses, 63-67). But it is not limited to these, for a few colors and at least one other effect--heat-- is due to a specific shape as well.

Aside from the effects of individual shapes of atoms, there are furthermore effects which groups, patterns, or combinations of atoms have on us. This, for instance, is the way in which the unnoticed effect of a certain kind of a geometric atomic figure is in fact perceived: a sufficiently large number of atoms of a certain shape have their effect on us and we notice it. And, if that which makes an impact on our sense-organs contains a variety of atomic shapes--which most objects

¹¹⁹Theophrastus, De Sensibus 64-68 (on flavors) and 73-78 (on colors), expands greatly on what Aristotle gives. Aristotle, although not going into detail, gives as much essential and basic information as anyone and enough, at any rate, to form an intelligent judgment about the theory. I shall here, as elsewhere, restrict myself to Aristotle's account (since this will best specify what is at issue), unless there is good reason to suppose that Aristotle is in error or that his information is too scanty or misleading.

apparently do--then the atomic shape which predominates in the group determines the perceived effect on us. But these are still mechanically fairly simple ways of producing an effect or sensation in us.

Other qualities, as they present themselves to us, are due to specific patterns in which the atoms which have their effect on our sense-organs are arranged; and these patterns or arrangements are described in terms of τροπή and διαθιγή. One physical object differs from another not only in its constituent atoms (which gives the nature of the object as such), but also by θέσις and τάξις;¹²⁰ and it is by change in this placement and order of atoms that Democritus claims alteration, change in qualities, takes place.¹²¹ And this is the reason (ὥστε--Gen. et Corr. 1.2, 315b11) that the same object may seem (δοκεῖν) different to various people; some small shift may bring about a different appearance: καὶ ὅλως ἕτερον φαίνεσθαι ἐνὸς μετακινήθεντος --315b13-14.

More specifically, a little later in the same passage (315b33-316a2), Democritus is said to make (a change in) quality due to the τροπή and διαθιγή of atoms--and here Democritus' own terms are used--and to assert that "an object takes on color because of the placement of atoms": τροπή γὰρ χρωματίζεσθαι. Theophrastus' listing of the various arrangements of

¹²⁰Gen. et Corr. 1.1, 314a24.

¹²¹Gen. et Corr. 1.2, 315b9: τάξει δὲ καὶ θέσει ἀλλοίωσιν. This is immediately thereupon connected with the claim that there is 'truth in appearances'--to be taken up shortly.

atoms for various colors has already been cited; this list provides examples of what is simply stated here.

But it is not only color as a sense-impression that is so explained. The resistance of the physical object to our touch, the feeling of hardness and softness is as well due to the τροπή καὶ διαθεῖν of its constituent atoms; the resistance of the object varies as the arrangement of its atoms varies. An object may seem now liquid, now solid or frozen for that reason.¹²² Again Democritus' own terms are used in the latter passage, and the identification is made more precise by the words καθόπερ λέγει Δημόκριτος.

To turn for a moment to the matter of the passage about the image or representation from the physical object to the percipient, there is one place at which Aristotle indicates that for Democritus the medium through which the image must pass to reach the percipient affects the accuracy with which he 'sees the object'.¹²³ But Aristotle does not say in what

¹²²Gen. et Corr. 1.9, 327a16-19.

¹²³Anima 2.7, 419a15-21. The interpretation of and confusion with this passage varies considerably. Its more detailed meaning will be taken up later.

But we may note here some of the divergence of opinion. Langerbeck, op. cit., p. 102, contends that this has nothing to do with a theory of sense-perception, on the grounds that this says nothing about images from the object to the percipient; for, if that were the case, Aristotle's criticism of it on the grounds that there was no contact between the percipient and the object would be meaningless. Guthrie, History, II, 443, feels the same difficulty in that air was for Democritus a medium and that Democritus for once must have been using the term κενόν loosely to mean 'empty air'. Ross, Anima, p. 244, has a basically correct interpretation, but says nothing about the type of difficulty about the medium which had been raised

respect the 'accuracy of seeing' is affected.

Perhaps one might nevertheless ask at this point what sort of an effect did Democritus think that the air as a medium would have on the accuracy of vision. Cherniss assumes the 'second theory' which he finds in Theophrastus and contends that the medium could "cause blurred and distorted images in the eye;"¹²⁴ but this would make nonsense of Aristotle's claim that for Democritus there was 'truth in appearances', even in Langerbeck's diluted sense of 'distinctness'. Cherniss then continues by saying that Aristotle's objection to this is that the "intermediate body is necessary which . . . itself affects the organ of vision."¹²⁵ But this is precisely what is involved in Theophrastus' 'second theory'--a

by Langerbeck and Guthrie.

There is what is called a 'second theory' ascribed to Democritus apparently by Theophrastus in his De Sensibus, which seems to say that the image from the object and an effluence from the eye meet in the air and the image which enters the eye is not the original image from the object, but a 'stamped copy' of it. Mugler (cited by Guthrie, History, p. 444, note 1) asserts, rightly I believe, that Democritus had not taught such an effluence from the eye and suggests that Democritus made the claim about seeing an ant at such a distance to forestall the criticism that the object would soon be exhausted with all the effluences necessary to account for seeing an object. Guthrie may be right in feeling discomfort at the account, but the fault seems to me to lie in Theophrastus' 'second theory' rather than in the accuracy or appropriateness of Aristotle's account or in Democritus' supposed 'loose usage'.

¹²⁴Op. cit., p. 165, note 100.

¹²⁵Ibid., p. 165. One might also ask Cherniss what he thinks one saw in the void without his vision blurred, assuming a 'second theory'. Surely not the atoms themselves! If simply a clear vision of an ant at that distance, why not the atoms themselves in things close at hand?

medium. Thus it seems highly unlikely that Aristotle here knew of or made use of a 'second theory'.

But this still leaves unanswered the question of how the air in general might affect the image. Perhaps one ought not attempt an answer, but there is a tempting solution that seems fairly obviously at hand to one who--like Democritus--took proper cognizance of the objects around him. And such an answer might well be that the air somehow diminished or compressed the size of the image--the greater the distance, the smaller the image. This would certainly allow images from obviously large objects like elephants--about which Guthrie wonders--to enter the eye; it would also explain the fact that images from such large things as planets might enter our eyes and why a group of them, although they are extremely far apart in space, might seem to us to merge and appear as a single comet.¹²⁶ This notion of the apparent size diminishing with distance is certainly not in disagreement with, and is more likely supported by, the reference in Vitruvius, who cites a composition by Democritus in which he describes in principle a theory of 'perspective' applied to scene-painting for tragic presentations.¹²⁷

¹²⁶Meteor. 1.6, 342b28. The planets appear to be in contact (ὁρίζονται θίγγειν), Democritus claims.

¹²⁷De Architectura VII, pref., 11: "quemadmodum oporteat ad aciem oculorum radiorumque extentionem certo loco centro constituto lineas ratione naturali respondere, uti de incerta re certae imagines aedificiorum in scaenarum picturis redderent speciem et quae in directis planisque frontibus sint figurata, alia abscedentia alia prominentia esse videantur."

Now to get back to Aristotle's account, this means that under normal conditions an ant on the vault of heaven would give off an image, and the image passing through the air would be continually decreased, so much so as finally to be imperceptible. But with no air--only void--intervening the image would remain the same size and so would be seen 'full scale'. Such a solution as to what here constitutes accurate ($\alpha\kappa\rho\iota\beta\acute{\alpha}\kappa$ --419a17) and non-accurate vision is certainly plausible and contradicts nothing else that we know about Democritus' teaching in this regard.

And so, in order now better to understand what is at issue in the so-called 'second theory' of images--as explained by Theophrastus, On the Senses, 50--we need first turn our attention to another passage in Aristotle, On Sensation 2, 438a5ff. There Aristotle had just finished giving an account of Empedocles' theory of vision which, he says, at times involves some light leaving the eye to meet the object: $\acute{\epsilon}\xi\iota\sigma\upsilon\nu\tau\omicron\varsigma\ \tau\omicron\upsilon\ \phi\omega\tau\acute{\omicron}\varsigma$ --437b26. Aristotle then concludes his account of Empedocles temporarily by saying: "Sometimes he says this is the way in which we see, but at other times he explains it by a theory of effluxes issuing from the objects seen."¹²⁸ At this point Aristotle introduces the account of Democritus, apparently not because Democritus, like Empedocles, held a theory of something like light or fire issuing forth from the eye, but because Democritus--Aristotle claims--was right about

¹²⁸Ross, Sensu, p. 49; 438a4-5.

the eye being water: ὅτι μὲν ὕδωρ εἶναι φησι, λέγει καλῶς -- 438a5-6; and thus Democritus was presumably at odds with Empedocles on this point. The eye, Democritus would say, functions as water (ἡ ὕδωρ--438a14) and not as what is transparent, and thus displays in it what we call a 'reflected image', just as would be the case with water in general or, for that matter, anything else which displays such a reflected image. Thus far there is no hint at all of a teaching of Democritus that the eye emits its own fiery (?) image,¹²⁹ but a rather strong intimation that Democritus rejected that first alternative of Empedocles and simply adopted the latter.

But what then does Aristotle attribute to Democritus in this passage? Democritus did believe--and in this Aristotle claims that he was wrong--that 'seeing is the appearance of the image in the eye': τὸ ὁρᾶν εἶναι τὴν ἔμφασιν (438a6), that is, that this visible image occurs in the eye because the eye, being water, acts the way water does in this case too. This is explained by Alexander as follows:¹³⁰

¹²⁹ Compare Ross, Sensu, p. 140; Robert B. English, "Democritus' Theory of Sense Perception" in Transactions of the American Philological Association, XLVI (1915), pp. 218-220; Guthrie, History, II, 443, and note 1. But such an interpretation involves the supposition that all water and reflecting surfaces emit such fiery effluxes as well, since the eye functions as water. And it is highly unlikely that Democritus taught this or that Aristotle thought or implied that he did.

¹³⁰ Diels-Kranz 67A29. The translation is basically that of Guthrie, History, II, 442. I have substituted for his "reflexion" "visible image" because "reflection" seems to me to anticipate the criticism of Aristotle and prejudice the meaning and intent of Democritus.

"Democritus says that to see means to receive the visible image from what is seen. The visible image is the shape which appears in the pupil, just as it does also in any other bright things which are capable of retaining a visible image. He believed (like Leucippus before him and the Epicureans after) in certain images emanating from things and similar in shape to the things from which they emanate (i.e., the objects of vision), which enter the eyes of the beholder, and that this is how vision occurs."

Again, there is no notion here of an emission from the eye or of a 'second theory'.¹³¹ Aristotle's remark at 438a26-29

about a theory of something leaving the eye (τὸ ἐξιόντι τινὶ τὴν ὄψιν ὁρᾶν) is a direct reflection of Empedocles' theory, and there is no reason to connect this with Democritus.¹³²

Thus vision for Democritus was to be explained in terms of an ἔμφασις, a visible image which results from the impact of the εἶδωλον on the watery nature of the eye; and he likely felt that this was supported by the image (visible to others as well) which appears on the pupil of the eye--likely assuming that a person's sense-perception at a given time was the same in appearance as the image which others saw in the pupil of his eye. Thus there would be some significance which Democritus might attach to this visible image, this ἔμφασις.

We may now, I believe, more profitably return to this vexing matter of what is reported to be a 'second theory' to

¹³¹As Guthrie, History, II, 442, rightly implies.

¹³²As Ross, Sensu, p. 140, does. Aristotle has finished with Democritus at 438a17 and--having established with the support of Democritus (which was his prime reason for citing him) that the eye is composed of water--continues simply with the criticism of Empedocles.

be found in Theophrastus' account. Theophrastus begins his account of Democritus' theory of vision in a way which is obviously and quite precisely just the matter which Aristotle had brought up in the passage from On Sensation 2: "Democritus explains vision by means of the visible image in the eye (ὁρᾶν μὲν οὖν ποιεῖ τῇ ἐμφόσει)¹³³ but he gives a unique account of this 'visible appearance'." Theophrastus then goes on to give an account of how this 'visible appearance' occurs at the eye and in the eye, an account which has nothing to do immediately with the passage of the εἶδωλον from the physical object to the eye, which is evidently assumed here. And what is assumed as well here, I believe, in Theophrastus' account is that 'what is seen' (τὸ ὁρώμενον) is not the physical object, but the εἶδωλον.¹³⁴ So, when the εἶδωλον reaches the eye, some air between the water of the eye and the εἶδωλον is trapped there, compressed, and impressed there by the εἶδωλον; this impressed air is then what 'shows up' in the water of the eyes (as well as in other 're-

¹³³Paragraph 50.

¹³⁴This is the only way, it seems to me, that any sense can be made of the assertion that "the air is compressed by 'what is seen' and by 'what sees' (i.e., the eye)": συσ-τελλόμενον ὑπὸ τοῦ ὁραμένου καὶ τοῦ ὁρῶντος. The physical object out in space certainly is not to be conceived as itself contributing directly to the compression of the air. And it is this image (as something physical) that Theophrastus feels obliged to explain in remarking that for Democritus ἅπαντος γὰρ αἰεὶ γίγνεται τινα ἀπορροήν: some effluences or images are constantly being produced by every object (and this image for Democritus, but not necessarily for others, would be 'what is seen').

flecting objects', I suppose). Thus there is no warrent at all here for assuming a special effluence from the eye¹³⁵ or for any alternate theory which has the εἶδωλον meeting such an effluence in mid-air, but we only have a more detailed mechanical explanation of precisely how it is that the εἶδωλον affects the eye; at the eye the εἶδωλον compresses some air, and this compressed air 'shows up' in the moist pupil of the eye. It is only a description of what happens in the act of seeing, which is precisely what Aristotle had said Democritus was explaining by ἔμφασις, and nothing more. Thus I would translate the passage in Theophrastus as follows:

"So Democritus explains the process of seeing by his 'visible appearance' (in the eye), but he gives a unique account of this. For he says that this 'visible appearance' does not occur directly in the pupil of the eye, but that the air between the eye and the 'image' is compressed by the eye and the 'image' and imprinted by the 'image'--for some effluence (or 'image') is constantly coming from every object; then this air which is now (more) solid and altered is what shows up in moist eyes."

So Aristotle's account is quite accurate, though it is not nearly as detailed a description as we have in Theophrastus.

Furthermore, these εἶδωλα are responsible, according to Democritus, not only for all instances of visual perception while awake, but also for the dreams that people see as well: εἶδωλα καὶ ἀπορροίας αἰτιώμενος.¹³⁶ That people do have visual presentations while asleep, that there is something which

¹³⁵As Guthrie, History, II, 443, does.

¹³⁶Div. somn. 2, 464a6; the whole passage now under consideration is 464a1-12.

even then affects their sense-organs, the soul, or the spherical atoms in them, seems quite certain; and that the physical object as such is not immediately present in such cases seems just as evident. And it is because of these facts, Aristotle says, that Democritus posits images and effluences--ἀφ' ὧν ἐκείνους τὰ εἶδωλα ποιεῖ καὶ τὰς ἀπορροίας (464a11-12)--as the reason why we have such visual presentations which we call dreams. And it may very well be that these considerations prompted Democritus to posit εἶδωλα as the reason for all visual presentations, awake or sleeping; and Aristotle's statement can certainly be taken in that sense. The problem of how to explain dreams in a mechanical and atomistic system might well have occasioned such a solution. Then, there being in effect no real distinction between dreams and other visual presentations from present physical objects, that solution might well have seemed appropriate to the latter instances of seeing as well.

We are now left with the task of considering the meaning of Aristotle's statements on a number of occasions¹³⁷ that Democritus supposed that 'what appears is true'. One major attempt to come to grips specifically with this problem is that of Helene Weiss.¹³⁸ A number of observations which she

¹³⁷ Anima 1.2, 404a27; Meta. 4.5, 1009b12; and Gen. et Corr. 1.2, 315b9-10.

¹³⁸ Op. cit., pp. 47-56. She is followed in substance by Guthrie, History, II, 454-465, who promoted the publication of her paper.

makes are worth considering. One might well share her distrust of the validity of earlier attempts to solve the problem either by denying the reliability of Aristotle and so making Democritus out to be a rationalist pure and simple or by making of him a sensationalist and so denying any real concern of his with reason or with Eleatic problems. She is certainly right in her attempt to do justice both to Aristotle's account and to that of Sextus Empiricus. And there is much to be said for the role of λόγος in the atomist theory of knowledge. But her solution is not really satisfactory either. She ends by saying that Aristotle did not really mean to imply that this was a Democritean proposition at all, that what Aristotle was doing in those passages was subjecting the "Atomists' views as a whole to thorough criticism," that Aristotle was really saying that, because the atomists had not come to his own understanding of νοῦς and νοητά--as its non-perceptible objects--this meant that they were seeking truth in appearance.¹³⁹ In order to avoid the Scylla of diluting the meaning of 'true', she steers into the Charybdis of giving it so precise and Aristotelian a meaning that it cannot apply to Democritus at all.

Granting for a moment that the meaning of 'true' might be in doubt in the two major passages which she considers (the ones at On the Soul 1.2 and at Metaphysics 4.5), she introduces the passage at On Generation and Corruption 1.2 as

¹³⁹Op. cit., pp. 55-56.

parallel statement, but fails to explain what Aristotle means here by saying, "they think that what is true is in appearing" (315b9-10), only assuring us that it is not a purely sensationalist meaning. Are we to suppose then that these atomists themselves thought that what is the object only of thought is in appearing? That is hardly satisfactory. How could Democritus have concluded from sense-appearance something about the atoms by supposing that connection alone? Her position is under the further disadvantage that she must outright deny any validity to the witness of Philoponus.¹⁴⁰

What then? Perhaps it is best to begin with the passage at On Generation and Corruption 1.2, 315b9-10: "Since they thought that what is true is in appearing and that appearances are both contrary and limitless, they made their (atomic) shapes limitless." If we accept this statement, we need ask then what sense of 'true' will allow us to make reasonable sense of this as a description of Democritus' theory. But to argue at all from sense-perception to atoms¹⁴¹ requires that they be related, that there be some sort of fixed and constant correspondence between the two realms; and this, I contend, is here the meaning of 'true' and 'truth'; it is a 'correspondence theory' of truth; it is somewhat like speaking of a proposition as being true if it corresponds to, correctly represents, some

¹⁴⁰Ibid., p. 55.

¹⁴¹This kind of an argument from sense-perception to atoms and void is in the background of the parallel passage at Metaphysics 4.5.

observable fact. There is a correspondence between the spherical shape and the feeling of heat that it produces, between a given pattern of atoms and the sensation of a specific color which it produces. And this 'truth' or 'correspondence' is insured by the εἰδωλον, which is an accurate representation of the physical object.¹⁴²

And this meaning of 'true' is appropriate too to the passage at Metaphysics 4.5, 1009b12: "Because they suppose that our knowledge of a phenomenal object is nothing more than our perceiving it, and that this is a (mechanical) alteration, they claim that our sense-impressions must necessarily correspond to the object as it actually is" (or we have no way of coming to know its atomic structure).

At On the Soul 1.2, 404a27 Aristotle ascribes to Democ-

¹⁴²Much of this is also to be found in Cherniss, op. cit. But he describes this (p. 82) as a way out of a difficulty, that is, an ad hoc explanation. But it rather seems to me an essential and basic point in Democritus' teaching, as we may see by the background of the statement in Meta. 4.5. Cherniss further speaks of deducing atoms from sensation; Bailey, op. cit., p. 182, speaks of inferring them. But Cherniss also takes back this meaning of 'true' first by calling it a certain degree of truth and then by reducing Democritus' meaning to "truth to be involved in perception." Bailey's account is closer to the mark (p. 184), but he restricts the meaning of 'true' somewhat, in the sense that it gives us information about atoms, void, and atomic complexes, if we will only disengage it from sensations that we get. I maintain that truth for Democritus is precisely this correspondence; for Democritus, in the midst of contrary sense-impressions, claimed that no one set of them is more true than another, if indeed truth is to be sought simply and solely on the phenomenal level; and this is why Democritus said that either nothing is true in this sensationalist meaning of true, or, if it is true in that sense, we have no evidence at all for it (ἡμῖν γ' ἄδηλον)--Meta. 4.5, 1009b10-12. So for Democritus 'what is true' must refer precisely to the correspondence of phenomena to reality.

ritus the teaching that 'what is true is what appears', and, if we take 'true' again in the sense indicated, that there is a persistent correspondence between sense-impressions and the state of atoms, then the identity of soul and mind in Democritus' theory is established inasmuch as the mind has no more to work on than simply is given to the soul in sensation. Thus, since the mind cannot perceive or judge truth as something special and distinct from what is given in sense-impressions (it cannot judge the correspondence, for it cannot 'perceive' or judge a resemblance when it is acquainted only with the 'picture' and not with the 'real object'), it is in this respect reduced to being nothing more than the soul; in perceiving by the senses one already receives and has what is 'true'. Hence Philoponus is right;¹⁴³ Aristotle deduced the identification of $\psi\upsilon\chi\eta$ and $\nu\omicron\upsilon\varsigma$ from 'correspondence', the truth of sense-impressions.

There is one further passage which may lend some support to a meaning of 'truth' as a correspondence between the object as perceived and as it is structured atomically; and this is at On Parts of Animals 1.1, 640b32-35: "(Democritus) says that the evidence is available to everyone ($\pi\alpha\nu\tau\iota$ $\delta\eta\lambda\omicron\nu$) as to what sort of an object a man is in his (atomic) structure ($\tau\eta\nu$ $\mu\omicron\rho\phi\eta\nu$), because he is recognizable as such by his shape ($\sigma\chi\eta\mu\alpha$) and his coloration." We do know that for Democritus color was due to a certain pattern of atoms, and this

¹⁴³Diels-Kranz 68A113.

correspondence does hold here; nor is there any reason why others should not hold as well. So, because these correspondences exist, there is much that one can infer about the structures of physical objects; we can recognize a man for what he really is. But without precisely this theory there is no way to argue from sense-perceptions to atomic structure. Such 'truth' was a necessary part of Democritus' atomism.

Now to return to On Generation and Corruption 1.2 and consider what directly follows upon the claim for truth in perceiving, the matter of appearances of contraries in the same physical object--which was a major concern in his positing this theory (Metaphysics 4.5)--Democritus solved by positing minute shifts and changes in the atomic structure of those objects: ὥστε ταῖς μεταβολαῖς τοῦ συγκειμένου τὸ αὐτὸ ἐναντίον δοκεῖν ἄλλῃ καὶ ἄλλῃ, καὶ μετακινεῖσθαι μικροῦ ἐμμιγνυμένου καὶ ὅλως ἕτερον φαίνεσθαι ἐνὸς μετακινηθέντος.¹⁴⁴ An εἶδωλον from the object was at any given moment a representation of the structure of that object. Thus, when a given percipient sees an object at two different moments, the object may have changed from one moment to the next and emitted two different εἶδωλα, each an accurate representation of the structure of the object at the time they were emitted. Thus visual contraries in the same object are explained. Differences in taste in a given container of water may well be due to the predominance of atomic geometrical shapes in the par-

¹⁴⁴Gen. et Corr. 1.2, 315b11-14.

ticular portion of the water tasted; and so, even under normal conditions, the same water may taste sweet to one, bitter to another.¹⁴⁵ Thus even in Democritus's theory the appearance of contraries in the same physical object is not at all inconsistent with there being 'truth in appearances'.

Now Aristotle's criticism of this theory of sense-perception rightly centers not only on the mechanics of effecting the sensation (the process of transferring the image into the resulting sensation), nor alone on some of the principles involved in these mechanics, but as well on the failure of the theory of correspondence as a whole to account for phenomena.

In reviewing this criticism we turn first to the passage in which Aristotle deals specifically with the εἰδωλα so necessary for sense-perception, On Prophecy in Sleep 2, 464a5-20. Democritus had claimed that εἰδωλα are responsible for dreams, and likely even, as we had noted, he had based his more general theory of εἰδωλα on this explanation of dreams (if not that, he had at any rate used what he had said in this specific account of dreams in his more general theory of vision). And Aristotle's criticism on this specific issue strikes at the roots of the atomists' explanation of perception. What Democritus had done, Aristotle claims in effect, is to bring the εἰδωλον as the efficient cause of sensation

¹⁴⁵This is not to deny that sickness or abnormality of the atomic structure of the person may also affect the sensation he gets; and even such a person's sensations are 'true'.

right to the percipient; and this is unnecessary, for the 'seen physical object' can affect a medium like air or water which can in turn produce the sensation in us; and this 'chain reaction of motion' can make it possible for sense-perception to take place without having the 'seen physical object' present: παυσαμένου ἐκείνου . . . τοῦ κινήσαντος οὐ παρόντος--464a8-9. The precise fact that sense-perception takes place in sleep and when the 'seen physical object' is obviously not present had likely brought Democritus to the point of explaining dreams by εἶδωλα which themselves are a present cause of perception, and thus to explain perception in general in that way. And so the whole theory rests on the mistaken assumption that the object of sight needs to be present for sense-perception to take place.¹⁴⁶

But, Aristotle further claims at On the Soul 2.7, 419a9-25, that not only is a continuous medium a better explanation, but is itself a necessary one. If the physical object is seen at all, it is seen in or through 'what is light': διὸ καὶ οὐχ ὁρᾶται ἄνευ φωτός --419a9. And this 'light' must be a potential characteristic of something continuous as a medium: ἢ δ' ἐντελέχεια τοῦ διαφανοῦς φῶς ἐστίν --419a11. But why such a medium at all? Because what evidence there is seems to require it-- σημείων δὲ τούτου φανερόν (419a12)--for if the

¹⁴⁶ Aristotle's criticism here is thus much broader than is indicated by the interpretation of Cherniss, op. cit., p. 166, for he claims that the εἶδωλον is only unnecessary in the case of dreams.

'seen object' is placed onto the eye itself,¹⁴⁷ no 'seeing' will occur (οὐκ ὄψεται); and this means that the only alternative is to have the 'seen object',¹⁴⁸ affect the transparent medium which in turn affects the eye. And this is precisely why Democritus is wrong, he says, about seeing by εἶδωλα in the void; the eye needs to be affected, but cannot be affected by the 'seen object'--and that, for Democritus, was the εἶδωλον, not the physical object. And so the only alternative left is to have the eye affected by the medium, which is thus established as necessary. And that is why with only void between the physical object and the eye, no vision at all will take place (οὐθὲν ὁφθῆσεται), because vision with the 'seen object' directly by contact affecting the eye results in no vision at all (οὐκ ὄψεται). It is the evidence of no vision resulting when what is (to be) seen is put directly into contact with the eye that refutes Democritus' theory and, incidentally, serves to establish Aristotle's own.¹⁴⁹

The very fact that the 'seen object' must directly affect the sense-organ means that sensation is reduced to contact with what is seen, the εἶδωλον (Sensu 4, 442a30ff.).

¹⁴⁷Hett's translation in the Loeb edition, p. 107, "close up to the eye" does not do sufficient justice to ἐπ' αὐτὴν τὴν ὄψιν.

¹⁴⁸I use this term here for clarity, because for Aristotle precisely that which one 'sees' in the strictest sense is color (Anima 2.7, 418a29-30).

¹⁴⁹Cherniss, op. cit., p. 165, more simply makes it the necessity of the medium which refutes Democritus' position.

But it is not difficult to see how such reduction of all sensations to contact is impossible (442b3-4).¹⁵⁰ But even beyond this, Democritus' system must use properties recognized by more than one sense-organ for each of the sense-organs. For instance, shape and roughness are obviously recognized by both sight and touch. But only in cases in which a property of the object is the peculiar function of only one sense-organ to perceive is there no possibility of error about it; there is no 'check' for it. But there is a possibility of error about what is recognized by more than one sense-organ; and these are the very properties which Democritus assigns to what is perceived, the very ones about which people make mistakes: διὸ καὶ περὶ μὲν τούτων ἀπατῶνται . . . οἱ δὲ τὰ ἴδια εἰς ταῦτα ἀνάγουσιν, ὥπερ Δημόκριτος --442b8-11. And this is the most damaging part of the criticism. They use for all the senses the very kinds of properties about which there is the greatest general error.

There is also here a second criticism (442b13-18), in that it is obviously more the function of sight than of any other sense to recognize and distinguish 'common properties'. But Democritus obviously would assign this function to 'taste', since he refers 'flavors' to the various shapes (442b13), which are the characteristics of the various atoms themselves;

¹⁵⁰There is no further explanation here as to how it is 'impossible'. The reference here most evidently is to the passage in On the Soul 2.7, which we have just examined. The specific arguments presented here in Sensu 4 are presented as additional considerations--ἐτι δέ.

and so it ought to be particularly sensitive to all the other properties capable of being perceived by more than one sense-organ: ὥστε ἔχρῃν τὴν γεῦσιν καὶ τῶν ἄλλων κοινῶν αἰσθά-νεσθαι μάλιστα--442b17. The other common sensibles include such characteristics as size, roughness, sharpness, unity, number, motion, and rest; and taste ought thus to provide the final criterion for these too. But this then is quite evidently contrary to experience.

When one comes to consider the sense-impression itself, Aristotle objects to Democritus' theory on a number of grounds. First of all, there is the mistake which lies at the very heart of atomism: the inability to deal with contraries at the phenomenal level. Democritus (and others) had gone on the assumption that, because contraries are perceived in the same object and because there is no reason to accept one contrary over the other, we cannot accept sense-impressions at face-value (Meta. 4.5, 1009b11ff). But this is to make a very basic mistake about the meanings of the word 'is'. A specific apple now green and later red is still the same apple; the apple, Aristotle would say, has not changed substantially, even though at one time it is a green apple and at another time it is a red apple. This is a mistake in that it fails to distinguish the object in itself, as that object, apart from its accidental properties (Meta. 13.4, 1078b25-26). This mistake thus led to an unwarranted interpretation of sense-impressions.

Furthermore, this mistake also led to another one, a one-sided view of action and passion (Gen. et Corr. 1.7, 323b10-324a9); it involves a denial that a thing can be affected in some sense by something contrary to it. But this is precisely what sense-impressions tell us is going on--something warm affects something cold. In opposition to what sense-impressions indicate, Democritus held that only like affects like, only another atom can affect an atom; and for him evidently this is also the way in which sense-impressions are made on soul.

While this, Aristotle says, may allow the soul to perceive the elements of which things are composed (Anima 1.5, 409b30ff.), still this atomic explanation allows no way of recognizing the phenomenal object as a whole object (409b32-33). Nor does it account in any way for recognizing qualities in objects; and so it is unreasonable (ἄτομον--410a23) to say that like is perceived only by like (410a24). The atomistic explanation of the sense-impressions is defective in this sense too, for, while it assumes that our sensations of 'secondary qualities' are due to atoms, it does not--and, in Aristotle's opinion, cannot--show how those qualities are derived from atoms and how they are recognized as such qualities.¹⁵¹

Moreover, in his only real attempt to account for such

¹⁵¹The attempt to do what Aristotle thought could not be done was impossible at the early stage at which biology, psychology, and chemistry were at the time of either Democritus or Aristotle.

sensed qualities, Democritus had taught that the εἶδωλον, when it reaches the eye, is made visible in the eye, and that the appearance of the εἶδωλα there is what constitutes vision. In response to this teaching Aristotle shows at On Sensation 2, 438a5-15 that this must be wrong, for what Democritus is talking about here is obviously only a case of reflection. But, he objects, the water of the eye evidently does not act primarily as water, as that which casts a reflection under such circumstances, but acts as transparent. Hence the reflection seen in the eye is quite incidental to the functioning of the eye in vision; if it were an essential in seeing, surely other water and other reflecting surfaces would 'see' as well, for such images become visible there too. This is one thing which makes his position an unreasonable one: ἄτοπον δὲ καὶ τὸ μὴ ἐπελθεῖν αὐτῷ ἀπορῆσαι διὰ τί ὁ ὀφθαλμὸς ὁρᾷ μόνον, τῶν δ' ἄλλων οὐδὲν ἐν οἷς ἐμφαίνεται τὰ εἶδωλα (438a10-13); Democritus uses a phenomenon which occurs in a variety of circumstances as though it were unique only to the phenomenon of seeing. Thus he has come to no clear differentiation between 'reflection' and 'becoming visible in' (438a9-10).

But there is one further problem raised in connection with Democritus' theory here, and that is that the image made visible--τὸ τὰ εἶδωλα ἐμφαίνεσθαι, or ἡ ἐμφασις--is said to exist in the eye (ἔστιν . . . ἐν ἐκείνῳ--438a8), which then

both reflects and sees it.¹⁵² But this, Aristotle claims, is wrong, for there is no εἶδωλον--as a physical object--there in the eye at all, inasmuch as what occurs as an image in the pupil of the eye is simply a case of reflection, and that is visible only to the man who sees it there (438a8) and not to the person in whose eye it appears.¹⁵³ What Democritus had taken for evidence for the existence of such a separate and visible image in the eye--and so evidence for what occurs in the act of seeing--has no reasonable basis at all.

But beyond these special criticisms of Democritus Aristotle shows that his theory of 'correspondence' breaks down in various ways and so is wrong; and it now remains in this section to give an account of these criticisms as they affect the theory of Democritus.

We may note first of all the way in which this correspondence theory breaks down by outlining a portion of the criticism of it by Aristotle at On the Parts of Animals 1.1, 640b29-641a9. Democritus had said that there was a correspondence between the (atomic) structure (μορφή)¹⁵⁴ of a human

¹⁵² Thus again it is the εἶδωλον in the eye which for Democritus is the 'seen object' and not the physical object.

¹⁵³ For a discussion of various interpretations of this passage, see Ross, Sensu, pp. 138-139.

¹⁵⁴ Cherniss, op. cit., p. 344, note 27, claims that the 'form' here for Democritus is the outer limits of the body. But I take οὐρμα to refer to the outline of the body (when abstracted from color), while μορφή refers to its structure. Thus Aristotle can speak here of a μορφή of the οὐρμα, a structure that belongs to the outlined shape; Aristotle had just used μορφή in that sense at 640a29.

being and the shape (σχήμα) and coloration which this structure presents to our senses (640a29-35). Aristotle objects that in that case a corpse (ὁ τεθνεῶς) has the same structure corresponding to that shape and coloration; the corpse and the man look alike, they present the same coloration and shape, but in that case they must be the same sort of physical object, have the same atomic structure; but they are obviously not the same: ἀλλ' ὅμως οὐκ ἔστιν ἄνθρωπος --640b36. Democritus would likely say that the corpse is different from the man in that the soul-atoms have left the corpse; but that would mean that the structure has changed without any visible evidence for it, and that too would leave him with no real correspondence between the physical object and its visible representation. Aristotle then goes on to list a number of other examples of correspondence; for example, the bronze hand--either abstracted from consideration of color or, more likely, colored--though it still bears the name 'hand', is not really a hand, even if it look ever so much like a hand; and these further illustrations of his point go on to show why in such instances correspondence fails.¹⁵⁵ But the point of Aristotle's criticism is clear enough; such correspondence will not work, and such appearances cannot themselves tell us enough about an object and very little about its atomic structure.

A further break-down is indicated by Aristotle at On

¹⁵⁵We may just briefly note here in anticipation that this takes no account of the function, purpose, or final cause; this will be taken up separately in the next chapter.

Generation and Corruption 1.8, 325b34-326b6, the whole point of which is to show the general unreasonableness with which Democritus says that sensible qualities are due to atomic shapes. It is not necessary to go through the argument again; an overview of the points Aristotle raises in opposition to the theory should be sufficient to show that these assignments of qualities do not in fact correspond with our sense-impressions.

First of all, our senses tell us that hot and cold are contraries; it is thus unreasonable to assign a shape to hot, but none to cold (326a3-6). Then too it is unreasonable to attribute to the atoms themselves the property of weight relative to their sizes without attributing other properties such as heat and hardness to them in the same way, so that one atom be harder or hotter than others. Or, why should one quality, weight, be due to a property of atoms while other qualities are not? (326a6-14); this certainly does not correspond with our sense-impressions. Nor again is there any reasonableness in attributing to them shape alone, for this is but one way in which they do correspond to larger physical objects; if in that one respect, why not in others (326a14-24)? Furthermore, our sense-impressions tell us of objects as divisible, and so it is also unreasonable not to attribute this too to atoms; size should be no objection (326a24-29). Our senses tell us of objects with a variety of qualities, reduced to their simplest form in earthy or fiery or similarly qualified objects;

why then should atoms not correspond to this? Or we see things of a like nature merging, and yet the atoms show no correspondence to this (326a29-34). All in all, any real correspondence between the world of atoms and void and the world of our sense-impressions breaks down completely.¹⁵⁶

There is also a general criticism of this sort by Aristotle at Metaphysics 8.2; this is in general an accounting of the kinds of differentia in physical objects. The chapter is introduced by mentioning Democritus specifically and his reduction of the kinds of real differences in physical objects to three (τρεῖς διαφορές --1042b12), shape, placement, and order. In contrast to this teaching of his Aristotle says that our sense-impressions indicate a great many (more) differences: φαίνονται δὲ πολλὰὶ διαφοραὶ οὔσαι --1042b15. He then goes on to list a great number of such specific differences; and he indicates that the perceptible ones present themselves as arranged in degrees in sets or categories of contraries: οἷον σκληρότητι καὶ μαλακότητι . . . καὶ ὅλως τὰ μὲν ὑπεροχῇ τὰ δὲ ἐκλείψει --1042b22, 24-25. These are the kinds of differences given us by sensation; and the implication here, particularly if we compare the passage to On Generation and Corruption 1.8, 325b34ff.,¹⁵⁷ is that Democritus' atomism cannot and does not

¹⁵⁶This interpretation, which sees in the criticism of Aristotle a rejection of Democritus' theory of correspondence, has the advantage of providing a unified object for the apparently wide range of criticisms offered.

¹⁵⁷Especially on sets of contraries and Democritus' unreasonable account of them.

account for them or for any real and thorough-going correspondence between the atomic system and our sense-impressions.

We may now go back to further criticisms that Aristotle offers at On Sensation 4, 442b19-26. Here the point is again raised about contrariety in sense-data, while there is no corresponding contrariety in atomic geometrical shapes:

"While all the sense-data (τὰ μὲν αἰσθητὰ πάντα) have contrariety, as, for instance, in the realm of color white is contrary to black, . . . while one shape does not seem contrary to another (442b19-22)." And a second objection which Aristotle voices here is that Democritus teaches a limitless variety of atomic shapes; thus, if each shape produces a specific flavor --and there is no reason to suppose that it would not--there should be a limitless number of flavors; and this is obviously not so.¹⁵⁸ So we have here two further ways in which the theory of correspondence, as held by Democritus, breaks down.

Finally, the irrationality of assigning perceived effects to shapes is the subject of the entire chapter at On the Heavens 3.8; though the chapter is devoted more specifically to a criticism of Platonic views, especially as they are expressed in his Timaeus, some of Democritus' views are criticized as well, for in this respect the views of Plato and De-

¹⁵⁸Cherniss, op. cit., p. 316, objects that Aristotle simply refused to recognize the possibility of imperceptible variations in color. But Aristotle is proceeding on the grounds of empirical evidence; how could we see or taste the difference if it is imperceptible? Besides, Democritus' theory is supposed to show correspondence to what we do perceive, and this is precisely where Aristotle says the theory fails.

mocritus are alike. For instance, the impossibility of assign-
 ing cold to a shape contrary to the sphere is repeated (307b7-
 10). There is as well the failure of the sphere to account
 for the uniting function of fire (307a32-b6). If anything at
 all the criticisms of Aristotle here show that by these theo-
 ries there is no correspondence between elemental shape and
 phenomenal effect; they are totally inadequate to account for
 differences which we perceive in objects: ὅτι μὲν οὖν οὐ τοῖς
 σχήμασι διαφέρει τὰ στοιχεῖα, φανερόν ἐκ τῶν εἰρημένων --
 307b20-21.

One might rightly extend this list of criticisms to in-
 clude all the instances in which Aristotle shows that atomic
 explanations do not correspond to what is given in sense-
 impressions. These, after all, are the most telling objections
 to a teaching that holds an atomic system of explanation and a
 theory of 'truth in appearances'.

The Intellect and Genuine Knowledge

Our information as to what Democritus taught about the
 intellect and its functions is even more sketchy than the in-
 formation we have on his theory of sense-perception. This has
 in recent years generated a number of attempts to reconstruct
 Democritus' theory of the intellect and the method of getting
 at 'genuine knowledge', the knowledge of the world of atoms and
 void. I have already indicated in the section prior to this
 on sense-perception some of the framework around which I be-
 lieve an intelligible theory of Democritus is likely to need

to be formulated; it centers around the meaning of 'truth in appearances', which on several occasions is attributed to Democritus by Aristotle.

But, since these attempts by various scholars at such a reconstruction offer some valuable suggestions, I propose in this section first of all to outline some of these attempts and the progress that has been made in this respect, and then to examine briefly Democritus' two kinds of γνώμη of which Sextus Empiricus informs us, then also to examine the picture which Aristotle provides us of Democritus' teaching (under the conviction that there is no inconsistency between it and the later witnesses), and finally to examine Aristotle's objections to this theory.

Langerbeck¹⁵⁹ proposed a gulf between 'genuine' and 'bastard' knowledge; all that empirical fact tells us is that we are separated from what is really true; and in this sense he interprets the statement of Sextus Empiricus: "Der Mensch muss aus dieser alles bestimmenden Beobachtung lernen, dass er vom Zuverlässigen entfernt ist."¹⁶⁰ Thus he would hold that for Democritus empirical fact is a κριτήριον or criterion only in this sense, and not in the sense that there is some sort of logical relationship between the realm of atoms and void and

¹⁵⁹Op. cit., especially pp. 112-118. This and other reconstructions are limited to the ones which tend to take seriously both Aristotle and later witnesses; this seems to be the only reasonable course to take.

¹⁶⁰Diels-Kranz 68B6; in Langerbeck, op. cit., p. 116; his interpretation of κριτήριον as 'observed fact' is on p. 115.

that of sense-perception; he denies the latter explicitly.¹⁶¹ One comes to genuine knowledge only by instruction ($\delta\iota\delta\alpha\chi\eta$ --Diels-Kranz 68B33); and, since he does attempt to account for Aristotle's information, he is driven to dilute the meaning of 'truth' and 'true'--as we have seen--to "Deutlichkeit", an unusual and totally unwarranted meaning.

Vlastos¹⁶² follows Langerbeck in the observation that teaching is instrumental in changing us physically, and indeed of 'changing our mind'. And this, I suppose, is a valuable insight, the strong emphasis on the physical alteration produced by teaching; this may very well be the means by which we come to understand the relationship between the realm of atoms and that of sense-perception.

We have already said much about the article by Helene Weiss. She argues that what Aristotle means by 'what is true' is 'being qua being'--or, at least, as close as Democritus got to that notion--and that this 'what is true', as a body with size, is still perceptible, though not perceived. She introduced a parallel passage from On Generation and Corruption 1.2, but had failed to show how her proposed meaning of 'what is true' applies to this passage, content to indicate that here

¹⁶¹In taking up the matter of a $\kappa\alpha\tau\omicron\nu$ in this fashion he is forced to alter the text of the title given in Thrasyllus (Diels-Kranz 68B10b): ΠΕΡΙ ΛΟΓΙΚΩΝ to read ΠΕΡΙ ΑΛΛΟΙΩΣΕΩΣ, "da es sich eben nicht um 'Logik' sondern 'Naturphilosophie' handelt." (pp. 116-117)

¹⁶²Gregory Vlastos, "Ethics and Physics in Democritus" in Philosophical Review, LIV (1945) 578-592, LV (1946) 53-64.

Aristotle saw nothing wrong with speaking of 'truth in appearances' and atoms together.¹⁶³ Had she searched out the meaning of this passage in more detail, she ought to have come to a clearer notion of what 'what is true' evidently means in these contexts. She rightly emphasizes the importance of λόγος in Democritus' system, but says that "the λόγος are an indirect grasping" or a "faculty of cognition," though not identified with νοῦς.¹⁶⁴ But this meaning does not apply in the passage from On Generation and Corruption 1.8, which she uses to illustrate her point; there she more appropriately uses the translation "reasons" for λόγος. One ought really take λόγος in that sense consistently, and then the 'reasons' would evidently be 'accounts of correspondence' between the two realms, atoms and phenomena.

Bailey, as we have already noted, is right about working from sensations to atoms to attain true knowledge by inference; but he proposes that the critical method of attaining that knowledge is the sense of touch; using it as the most valid, we must strip impressions gained by the other senses of their 'secondary qualities', and thus by a method of abstraction and inference gain a 'genuine knowledge' of things.¹⁶⁵ The idea of inference is certainly valid here as well as the

¹⁶³Op. cit., p. 52.

¹⁶⁴Ibid., p. 51; she takes λόγος as being a Democritean term.

¹⁶⁵Bailey, op. cit., pp. 182-185. But the sense of touch is itself in the same state as the other senses.

primacy of touch. But for Bailey 'what is true is in what appears' is reduced to 'appearances contain the data for true knowledge'; this is inadequate, for we require a meaning which will allow us to go from one realm to the other, that is, we require some sort of formal relationship between them.

Guthrie for the most part follows Weiss, but still feels dissatisfied with her account. Bailey had considered and then rejected the notion of atoms by-passing the senses and affecting the mind directly. Guthrie takes up the principle, but speaks of atomic films after passing through the eyes and ears being dispersed throughout the body, and then he goes on to say that "something like this is perhaps what Bailey and others have meant by 'inference'."¹⁶⁶ But again, some such process as this certainly cannot be of help in arguing from sensations to atoms, as the passage at On Generation and Corruption 1.2 seems to require.

Finally, Taylor indicates that 'truth in appearances' comes down to saying only that any one sense-impression is as true as any other--and this is entirely subjective--while the only non-subjective truth is the scientific (atomic) explanation.¹⁶⁷ But the 'scientific explanation' is itself always subject to correction by empirical evidence; whenever one has a sense-impression for which the scientific explanation fails

¹⁶⁶Guthrie, History, II, 465.

¹⁶⁷C. C. W. Taylor, "Pleasure, Knowledge and Sensation in Democritus" in Phronesis, XII, 1 (1967), p. 24.

to account, the scientific explanation must be corrected. Thus 'truth in appearances', while it here at last seems rightly to imply a real correspondence, is reduced to a totally solipsistic sense:¹⁶⁸

"Every individual has his own common-sense picture of the world, none of which is truer than any other; the only inter-subjectively true picture is the scientific one, which can however claim to be true only in so far as it provides an explanation of every common-sense picture, an explanation moreover which depends for its verification on the same potentially conflicting data of perception."

Several objections can be raised against this interpretation. One thing that seems to make Taylor's analysis subject to suspicion is its apparently artificial parallelism to the 'theory of pleasure'; he himself looks upon this as a confirmation of his analysis. Furthermore, there is no real evidence that sense-impressions for Democritus were as private and totally subjective as Taylor makes them out to be; indeed, there is indication to the contrary. The very passage in which Democritus claims that the 'secondary qualities' are not 'real properties' of physical objects certainly implies that they are not merely subjective: νόμος χροίῃ, νόμος γλυκύ, νόμος πικρόν, ἑτεῖη δ' ἄτομα καὶ κενόν -- "color, sweet, bitter exist only by convention, but atoms and void exist in reality."¹⁶⁹ This evidently implies that there is some one kind of sensation that all (or a majority) call either 'red' or 'bitter' or

¹⁶⁸ Ibid.

¹⁶⁹ Diels-Kranz 68B125 (=B9).

'hot' or 'cold'; and the detailed account in Theophrastus, De Sensibus, certainly confirms this, for this system was evidently meant to account for all our sensations of red, bitter, and such. Taylor, I believe, was right about the truth of sense-impressions, but wrong about their being subjective; any number of people certainly can look upon the same green object and get the same sensation of greenness simply because there is an objective atomic configuration which accounts for all such sensations; there is nothing in Democritus to indicate the contrary. There is indeed an objective reality which sensations represent directly. Sensation, Democritus would obviously say, are indeed relative--relative to the objective structure of the physical object, relative as well (in cases of abnormality in the percipient) to the soul-structure of the percipient, and perhaps relative as well to some other factors; but it does not follow from the fact that they are relative that they are also subjective.¹⁷⁰

Sensations are true for Democritus not because they are

¹⁷⁰Incidentally, Taylor, op. cit., pp. 14-15, weakens the sense of Diels-Kranz 68B33, emphasized by Vlastos, by down-grading the mechanical implications of "Teaching changes a man, and in changing him forms his character"--ἡ διδασχὴ μεταρρυθμοῖ τὸν ἄνθρωπον μεταρρυθμοῦσα δὲ φυσιοποιεῖ. Taylor prefers to take this simply as a traditional saying with little distinctive meaning and apparently little or no connection with Democritus' physical theory. But then it is strange that Democritus would bother using a verb based on ῥυθμός (a distinctive Democritean term), even though the term would not be here used precisely for 'atomic shape'. There may well be a sense in which 'teaching' forms our thinking in a sense appropriate to Democritean physics; it may for one thing form our thinking to recognize a correspondence between sensation and atomic structure.

subjective and private, but precisely because they are grounded in objective reality, because they are a mechanical alteration of a specific kind.

According to Sextus Empiricus there are two terms which have come down to us from Democritus, signifying two kinds of knowledge, genuine and obscure: γνῶμη γνησίη and γνῶμη σκοτίη.¹⁷¹ There is little doubt about their meanings; both are instances of 'knowledge', but each of a different sort. γνῶμη σκοτίη is the knowledge that comes through sensations (τὴν δὲ διὰ τῶν αἰσθήσεων σκοτίην), which gives us all sorts of information on the phenomenal level. But there is a point in fineness beyond which this perception on the level of sensation can not go, and it is beyond this point that the world of atoms and void lies, the world of things as they really are, genuine being and non-being. This latter is the world which γνῶμη γνησίη knows.

But here is precisely where the problem lies: how does one get from 'obscure knowledge' to 'genuine knowledge'? I would briefly add here to the already long list of attempts to bridge that 'knowledge gap' by what seems to me can reasonably be learned about Democritus' teaching and from Aristotle's criticism of him. Evidently the existence of contraries in the same object provides dissatisfaction with 'obscure knowledge'. If λόγοι is a Democritean term, it is likely that it refers to accounts of correspondence between the two levels of

¹⁷¹Diels-Kranz, 68B11.

knowledge; for example, that sensation which we call 'heat' corresponds to the spherical atoms. It is somehow our nature --evidently by convention--to accept at face value the picture of the world received through sense-perceptions; but we may be trained by teaching (διδασχῆ), perhaps by teaching the λόγοι, to recognize that the correspondence exists between the two levels, and thus to know by inference--the way one would know the conclusion of a syllogism, though he had no direct experience of it--the world of atoms and void. And this latter knowledge, including knowledge of the atomic structure of things, would be 'genuine knowledge'.

As we now go on to the report of Aristotle on Democritus' teaching about intelligence and knowledge, we have a most striking statement made by Aristotle, that for Democritus mind and soul are the same thing;¹⁷² and it is striking because we have thus far been led to expect that they would be distinct for Democritus. On the other hand, Philoponus, in his commentary on On the Soul, says that Democritus had explicitly denied their identity, and that Aristotle had only concluded their identity as a logical consequence of other teachings about mind.¹⁷³ While Philoponus is evidently quite right in his statement, this is not to say that Aristotle was evidently in

¹⁷²For instance, twice within a few lines in Anima 1.2, 404a28, 31: ἀπλῶς ταῦτόν ψυχὴν καὶ νοῦν, . . . ταῦτό λέγει ψυχὴν καὶ νοῦν.

¹⁷³P. 71, lines 19ff., Diels-Kranz 68A113: ἔχομεν οὖν τοῦτο ἐνεργῶς παρ' αὐτῶν εἰρημένον ὅτι ταῦτόν νοῦς καὶ ψυχὴ οὐδαμῶς, ἀλλ' ἐκ συλλογισμοῦ τοῦτο κατασκευάζει.

error on this point. 'Same' for Aristotle does not necessarily mean absolute identity; things may be the same inasmuch as they have some accidental or essential property in common;¹⁷⁴ thus things may be 'the same' in some respect. So this means that when Aristotle says that for Democritus mind and soul are the same, we are not to conclude necessarily their absolute identity; we are rather first to inquire as to the respect in which they are the same. Aristotle and Philoponus are not at odds on this point. With this in mind let us then examine Aristotle's report.

According to Aristotle the intellect in Democritus' teaching is the same as the soul, in the first place, inasmuch as they are composed of the same material, the same kind of atoms--small and spherical. Aristotle says this twice. Soul and intelligence, he claims, are the same in the atoms of which they are composed, "moveable because of (the atoms') small size and shape, and the shape he (Democritus) claims is the most mobile of atomic shapes."¹⁷⁵ This is repeated, though not as precisely, at On Breathing 4, 472a7-8, where Aristotle speaks of Democritus' teaching that we breathe in from the air those atoms which he identifies with intelligence and soul. Thus both are identical in their matter.

¹⁷⁴ Compare Metaphysics 5.9 on ταύτα. This may be the problem as well when Aristotle says that two philosophers have the same teaching on some particular issue; we must then also be careful to distinguish precisely in what respect they are the same.

¹⁷⁵ Anima 1.2, 405a10-12.

Again Aristotle says that for Democritus the operation or activity of both the soul and the mind are of the same sort; they both consist of a mechanical alteration; thus, since the process is a purely mechanical one, the impression which the senses get must be true.¹⁷⁶ This statement of the mechanical relationship between sense-impressions and the object again gives Aristotle reason for declaring the identity of soul and intellect in On the Soul 1.2, 404a28-30. Here Aristotle adds the remark which to him seems to establish what he had just said, that for Democritus the νοῦς does not function as a special capacity which can distinguish and judge truth: οὐ δὲ χροῖται τῷ νῷ ὡς δυνάμει τινὶ περὶ τὴν ἀλήθειαν --404a30-31. What is true is the sense-impression itself; thus the soul takes from νοῦς a function which the latter should have if both are to be distinct, and νοῦς itself simply infers atoms and void in certain positions. Both νοῦς and ψυχὴ are identical in their functioning mechanically by alteration.

Finally, there is a third respect in which intelligence and soul are alike, in having the same 'object'--a body with size, and hence perceptible even if not actually perceived or noticed. Aristotle shows at On Sensation 6, 445b3-446a21 that even when one gets down to the atomic level (ἄτομα . . . μεγέ-
 0η--445b19), as long as one is dealing with magnitudes, there are still objects perceptible at this level--whether or not they are perceived in isolation. Again, at On the Heavens 3.7,

¹⁷⁶Metaphysics 4.5, 1009b12-15.

306a28-30 there is mention of some who will not yield divisibility to what is perceptible: οἱ δὲ οὐδὲ τὸ αἰσθητὸν ἅπαν συγχωροῦσι διὰ τὸ βούλεσθαι σώζειν τὴν ὑπόθεσιν. In neither passage are the authors of the theory in question mentioned, but the remarks are quite appropriate to Democritus. Inasmuch as an atomic figure has size, it is at least potentially perceived. And in that respect at least, in that the object of intelligence is to some extent perceptible, the object of perception and of thought is the same.

Thus Democritus' soul and intelligence are the same, but the same only in the above respects, the same inasmuch as they are composed of the same matter, as their operation is of the same kind, and as their objects are basically the same. But this ought not lead us, as Philoponus rightly warns, to assume a complete identity of both.

There is at least some indication that Democritus argued from sense-impressions to atoms; and this may also be the way in which he thought that intelligence operates: it uses a phenomenon and, by the theory of correspondence, infers something about the atomic world. This is what Aristotle describes as taking place at On Generation and Corruption 1.2, 315b9-11: "Since they believed that what is true is in appearance, and since appearances are contrary and limitless, they suppose that the atomic shapes are limitless."¹⁷⁷ It was the limit-

¹⁷⁷ ἐπεὶ δ' ᾤοντο τάληθές ἐν τῷ φαίνεσθαι, ἐναντία δὲ καὶ τὰ φαινόμενα, τὰ σχήματα ἅπειρα ἐποίησαν.

less variety of appearances which, in conjunction with the further premise of truth in appearances, allowed a conclusion about atomic shapes.

Furthermore, later in the same book, Aristotle commends Democritus for "making his starting point accord with nature just as it is,"¹⁷⁸ that is, the object as it appears. In the world of nature just as it is he had found motion, and concluded from that that on the atomic level of explanation there must be a void: ὡς οὐκ ἐν κίνησιν οὖσαν ἄνευ κενοῦ.¹⁷⁹ And his argument in this passage goes exactly in the opposite direction from the Eleatic argument (which goes from the non-existence of the void to the non-existence of motion) from the fact that there is motion in the phenomenal world to the existence of void on the atomic level.

And it may well be that this is how Democritus thought that intelligence in general operates, using the information of the senses--and assuming a correspondence (which amounts to a 'programming' of the mind as one might program a computer)--to arrive at an atomic world which truly is.

What then are we to make of Democritus' quotation with approval from Homer: ὅτι ἐποίησε τὸν Ἑκτορα, ὡς ἐξέστη ὑπὸ

¹⁷⁸ Gen. et Corr. 1.8, 325a1-2: ἀρχὴν ποιησάμενοι κατὰ φύσιν ἥπερ ἐστίν. There is, I believe, no need to read ἥπερ ἐστίν, as Joachim, op. cit., p. 159, suggests just to accord with Parmenides; what we have in the lines that immediately follow this remark is more of a contrast with the Eleatics than a similarity with them.

¹⁷⁹ Gen. et Corr. 1.8, 325a27.

τῆς πληγῆς, κεῖσθαι ἀλλοφρονέοντα?¹⁸⁰ This citation with approval is presented in the passage from On the Soul as a consistent consequence of 'what is true is what appears' (τὸ γὰρ ἀληθὲς εἶναι τὸ φαινόμενον, διὸ καλῶς ποιῆσαι . . .--404a28-29), and so ought probably be connected with drawing inferences from phenomena to the actual or real situation. What Democritus probably conceived to be the case with Hector was something like this: Hector was receiving sense-impressions just like anyone else might, but because of the unusual state of his physical condition (ὥς ἐξέστη ὑπὸ τῆς πληγῆς) he was drawing wrong conclusions from them about objective reality, as if an instance of false knowledge were an instance of knowledge: ὥς φρονοῦντας μὲν καὶ τοὺς παραφρονοῦντας ἀλλ' οὐ ταύτα--Meta. 4.5, 1009b30-31. One might conclude from this that each of the following were instances for Democritus of the functioning of νοῦς or φρόνησις: intelligence inferring from phenomena the reality of atoms and void, intelligence inferring from sense-data that physical objects have all the qualities as properties which we perceive them to have, and intelligence inferring from sense-data conclusions contrary to both appearances and atomism. The second is the common-sense view of the world, but, because of contraries in the same object, cannot be the real situation; and men apparently are

¹⁸⁰Meta. 4.5, 1009b29-30, though here there is no specific attribution to Democritus. The information, however, is repeated at Anima 1.2, 404a30, where this is more explicitly referred to Democritus. The quotation as made is not in our texts of Homer.

habituated to this kind of inference. The first is the genuine functioning of knowledge and must be instilled, likely by teaching, to change us and get us out of the habit of using the second kind of inference. The third, likewise mistaken, is due to a derangement of our atomic structure. The mind or intelligence then is not a special faculty concerned with truth; its functioning in this respect is not distinguished from the functioning of soul in general, for it too, like the soul, is liable to error--mechanical errors, but errors nevertheless: οὐ δὴ χρῆται τῷ νῷ ὡς δυνάμει τινὶ περὶ τὴν ἀλήθειαν, ἀλλὰ ταύτῃ λέγει ψυχὴν καὶ νοῦν --Anima 1.2, 404a30-31.

The above reconstruction of the teaching of Democritus on intelligence and genuine knowledge--though it remains only a reconstruction--has the advantage of the consistency for which Aristotle praised Democritus, of taking the reports of Aristotle seriously, of being consistent with later witnesses to the teaching of Democritus, and thus of not giving Aristotle a 'straw man' to 'knock down' without any difficulty.

As we begin then to account for Aristotle's specific criticisms of this teaching, we may not that one important aspect of that teaching has already been taken into account. Aristotle, as we have seen, had raised his objections to the theory of correspondence between sense-impressions and physical objects; he had quite rightly shown that this proposed correspondence breaks down at critical points. Without repeating those criticisms here we might yet note that this is

probably the most telling objection which Aristotle raises against such a theory of knowledge.

Now aside from this, there is another criticism which Aristotle uses against Democritus, one which is probably the most well known, that is, that Democritus' teaching implies the identity of mind with soul and fire. This criticism was raised, for instance, at On the Soul 1.2, 404b27ff. As was mentioned above, this is not to be taken to say either that Democritus taught their complete identity or that Aristotle thought or implied that he did.¹⁸¹ The point that Aristotle raises here is only the identity of their material--spherical atoms--and that these atoms are meant to explain the extreme mobility involved in explaining the operation of all three kinds of objects. But, in view of their sameness of material and of operation, this amounts to a practical identity of the three, especially since we--and Aristotle as well likely--lack any information on specific differences between them. This is, it seems to me, what allows Aristotle to identify them by syllogism; only their sameness was specified and expanded upon, but not their differences. Perhaps we may use here a statement made by Aristotle in another context, for it does summarize neatly the force of his criticism here: λεκτέον τὴν διαφοράν, ἀλλ' οὐχ ἀπλῶς οὕτω λεκτέον ὡς λέγουσιν --"one ought to specify the difference and not make as simple a claim as they do"--Caelo 3.8, 307a23-24. The identity of mind with

¹⁸¹As Cherniss, op. cit., p. 289, does.

soul and fire is a theoretical one, due to Democritus' failure to specify specific differences between them. Democritus is at fault for failing to make a distinction which is important to his theory.

We now turn our attention to another passage in On the Soul where Aristotle offers a further major objection to Democritus' teaching about mind and knowledge; this he does at 1.2, 404a25-31. But, before proceeding with the major criticism, this passage also brings up another matter: Aristotle mentions Anaxagoras and anyone else who has claimed that mind sets things in motion, and then Aristotle continues by claiming that Democritus too taught the capacity and function of mind to set things in motion: καὶ εἴ τις ἄλλος εἶρηκεν ὡς τὸ πᾶν ἐκίνησε νοῦς· οὐ μὴν παντελῶς γ' ὥσπερ Δημόκριτος -- 404a26-27. So for Democritus the mind is no better off than the soul in this respect; and the criticism which Aristotle had offered against this teaching of Democritus about the soul applies as well to the mind: since movement is a mechanical one, and since the spherical mind-atoms are naturally in motion, it will either be impossible or, at least, quite difficult for it to cause rest and cessation of motion: ἡμεῖς δ' ἐρωτήσομεν εἰ καὶ ἡρέμησιν ποιεῖ τοῦτο αὐτό· πῶς δὲ ποιήσει, χαλεπὸν ἢ καὶ ἀδύνατον εἰπεῖν -- Anima 1.3, 406b22-24.

Now to return to the major objection at On the Soul 1.2; we have there the statement that for Democritus what appears is what is true, Democritus' approval of the Homeric descrip-

tion of Hector lying wounded with his thoughts elsewhere; and it is in this context that Aristotle makes the simple critical statement that Democritus does not use the mind as a faculty or power concerning the truth (404a30-31), with no further explanation other than the fact that νοῦς is the same as ψυχή in this respect. So we need to turn to the parallel passage in the Metaphysics for details and elucidation of this criticism.

At Metaphysics 4.5, 1009b12ff. the claim that for Democritus there is truth in what appears is repeated, then the quotation from Homer is cited a number of lines later. There then follows a more detailed account of Aristotle's objections to this teaching. And his objection is generally this: by Democritus' theory no more is given from the object than what is given to the senses, or, in another way, that what intelligence has as its object is precisely the same--no more, no less--as what sense-perception has as its object; or again, more simply, that as to its object intelligence is sense-perception: πρόνοιον μὲν τὴν αἴσθησιν --1009b13.¹⁸²

More specifically Aristotle claims on the basis of the approval of the passage from Homer that this teaching involves the claim that an instance of mistaken knowledge is an instance of knowledge, or, perhaps, that error is an instance of truth:

¹⁸²Cherniss, op. cit., p. 83, assumes that it is only on the grounds of the material of which νοῦς is constructed that Aristotle claims the sameness of soul and mind. It is not a matter of material, and the intellect does not stand "in judgment over sensation," as Cherniss claims; it uses sensation.

ὡς φρονοῦντας μὲν καὶ τοὺς παραφρονοῦντας, ἀλλ' οὐ ταῦτά--
 1009b30-31. But this means further that, since both are ac-
 tivities of the mind and each 'sees' truth as something con-
 trary to the other, contraries are in fact and actually true
 of the same physical object at the same time: καὶ τὰ ὄντα
 ἅμα οὕτω τε καὶ οὐχ οὕτως ἔχει --1009b32-33. Thus they are no
 closer to any fixed truth than they were before, when just
 using sense-perception; the pursuit of truth, of what physical
 objects are really like, on this theory is a 'wild goose
 chase': τὸ γὰρ τὰ πετόμενα διώκειν τὸ ζητεῖν ἂν εἴη τὴν
 ἀλήθειαν--1009b38-1010a1.

Furthermore, Aristotle goes on to say, the reason for
 their mistaken point of view is that these men assumed that
 only perceptible objects exist: τὰ δ' ὄντα ὑπέλαβον εἶναι τὰ
 αἰσθητὰ μόνον--1010a2-3.¹⁸³ This undue emphasis on sense-
 perception brought on a neglect of that in a physical object
 which remains constant in the midst of accidental change, its
 essence; they look only at what is changing about an object,
 not at what is permanent about it in the midst of such change,
 and therefore they can find nothing true about the object which
 presents itself to the senses: ὁρῶντες ταύτην κινουμένην τὴν
 φύσιν . . . περί γε τὸ πάντῃ πάντως μεταβάλλον οὐκ ἐνδέχασθαι
 ἀληθεύειν--1010a7-9. But it is the distinctive function of
 the intellect to 'perceive' that permanent nature of a physical

¹⁸³See Cherniss, loc. cit., " . . . assumed that only
 sensible things had real existence."

object--and that, for Aristotle, is what is true and lasting about a given physical object. And in this sense Democritus fails to use the intellect as a power concerning truth; his intellect had no distinctive power to 'perceive' what is true and permanent about an object--in contrast to what is changing about it--precisely because intelligence had absolutely no more to work with than was already given in sense-perception.¹⁸⁴

If what is true is to be permanent and the attainable object of intelligence, then Democritus' theory is thus deficient on two counts: it allows two contrary truths about the same object at the same time if both a correct and a mistaken $\varphi\rho\acute{o}\nu\eta\sigma\iota\varsigma$ are instances of real intelligence; and, secondly, it allows for nothing permanent about an object, although this is the way we see the object and speak of it; on Democritus' theory the apple now green and later red is not the same apple, but is on each occasion a different object.

Democritus' theory of knowledge and of correspondence breaks down and cannot arrive at a sure truth, and thus on this critical point the whole world of atoms and void is thrown into doubt along with his theory of knowledge.

¹⁸⁴The point about there being no knowledge of what is merely perceptible, and so, changing, that there must be some more permanent nature ($\varphi\rho\acute{o}\sigma\iota\varsigma$) of an object which is given to $\varphi\rho\acute{o}\nu\eta\sigma\iota\varsigma$ (or $\nu\omicron\upsilon\varsigma$) is repeated at Metaphysics 13.4, 1078b12-17.

CHAPTER IV

ON FORMAL, EFFICIENT, AND FINAL 'CAUSES'

Introduction

The final fundamental issue which divides the teaching of Aristotle from that of Democritus revolves around the question of the kinds of explanations they give of physical objects and events. To put this into traditional Aristotelian terminology, this is the issue of the four causes--material, formal, efficient, and final--all of which the natural philosopher must consider, Aristotle says, if he is to render an adequate account of the world about us.¹

Immediately at this point we run into a difficulty; there is still active discussion on precisely what is meant by 'cause' in Aristotle, particularly in reference to the 'final cause'. On the one hand, Ross, for example, tends to describe the 'final cause' as one of "the external conditions of natural process," and, at that, as a force working on a par with the efficient cause.² This interpretation makes in effect a

¹Physics 2.7, 198a22-24: ἐπεὶ δ' αἱ αἰτίαι τέτταρες, περὶ πασῶν τοῦ φυσικοῦ εἰδέναι, καὶ εἰς πάσας ἀνάγων τὸ διὰ τί ἀποδώσει φυσικῶς, τὴν ὕλην, τὸ εἶδος, τὸ κινῆσαν, τὸ οὐ ἔνεκα.

²Ross, Physics, p. 36; also W. D. Ross, Aristotle: A complete exposition of his works and thought (New York: Meridian Books, 1959), p. 76, where the final cause is a 'vis'.

second sort of efficient cause out of the 'final cause'.³ On the other hand, Charlton contends that it is misleading to talk of these Aristotelian causes as all being ones which actively operate and produce effects, that Aristotle's doctrine of the "'four causes' is an attempt to distinguish and classify different kinds of explanation, different explanatory roles a factor can play."⁴

It is this latter sense of 'cause' which seems to me to come closer to what is meant by the term in Aristotle's doctrine of the 'four causes'. The word 'cause' has come to mean for us in ordinary language something more nearly like what we shall see it meant for Democritus--an 'efficient cause'. But it is obvious that its meaning for Aristotle is much broader: whatever can contribute to the explanation of a physical object or event would for Aristotle be an αἰτία, a reason, an explana-

³There is, of course, a sense in which the efficient cause may be at times identical with the final cause, just as a particular musician may be identical with a housebuilder, when he builds a house. But in that case the musician is not acting qua musician, but qua housebuilder. Similarly the efficient cause qua efficient must be kept intellectually distinct from the final cause qua final. See also Gen. et Corr. 1.7, 324b14: τὸ δ' οὐ ἐνεκὰ οὐ ποιητικόν.

⁴Op. cit., p. 99. This same sort of contention is also the substance of a very recent article on Aristotle's 'unmoved mover', which by this interpretation is not a personal force and thus an efficient cause, but is simply "an explanation for orderly rational motion"--Dimitri Z. Andriopoulos and James M. Humber, "Aristotle's Concept of ΤΟ ΠΡΩΤΟΝ ΚΙΝΟΥΝ ΑΚΙΝΗΤΟΝ: A Reexamination of the Problem" in Classical Journal, LXVI, 4 (1971), p. 293. This article raises the basic question as to whether for Aristotle the 'unmoved mover' is to be conceived as a personal god.

tory factor.⁵ This interpretation has the advantage of making more sense of what Aristotle says, for instance, where he criticizes Anaxagoras' νοῦς as not being an adequate explanation as 'final cause'; Anaxagoras' νοῦς, though taken as 'the good', still is only that which sets the universe in motion originally as something separate and mechanical ('Αναξαγόρας τε γὰρ μηχανῇ χρῆται τῷ νῷ πρὸς τὴν κοσμοποιΐαν --Metaphysics 1.4, 985a18-19); although it is 'the good', it still does not explain the present functioning and purpose of the universe, that for the sake of which that original motion as well as the present motion takes place. Cherniss' objections to Aristotle's criticism only hold when efficient and final causality are confused, only when the 'final cause' is in effect another kind of efficient cause, when there is no distinct purpose for the motion: ἀλλὰ κινεῖ ἕνεκά τινος, ὥστε ἕτερον --Metaphysics 12.10, 1075b9.⁶ Thus, what Aristotle is saying against Anax-

⁵This meaning has been found for αἴτια already in Plato and applied by Gregory Vlastos to Aristotle in his "Reasons and Causes in the Phaedo" in Philosophical Review, LXXVIII, 3 (1969) 291-325.

⁶Cherniss, op. cit., p. 235, says: "To complain that he [Anaxagoras] identified final and efficient causality in the νοῦς is not only unhistorical but also inappropriate for Aristotle whose God, pure intellectual activity, is at once the efficient and final cause of movement in the universe." Cherniss' criticism implies that Aristotle is wrong in criticizing Anaxagoras, because Aristotle's own teaching is the same. But this fails to distinguish their differences. The fact that νοῦς may be the only primary efficient cause of motion in general for Anaxagoras and not the proximate cause of any other motion is in itself immaterial to the question as to whether it is to be labeled as an efficient or final cause (contra Cherniss, loc. cit.).

agoras is that his *voûç* only explains the order in the universe from the point of view of giving an efficient cause, albeit a 'good efficient cause', but fails to give an explanation which takes into account its present order from the point of view of its purpose and proper functioning. The confusion, it seems to me, is due to an interpretation which fails to keep the final cause, qua final, distinct from the efficient cause. And this can likely best be done by remembering that 'cause' has a much broader meaning for Aristotle than it has for us, that its meaning more closely approximates 'explanation' or 'explanatory factor' than 'cause' in the strict sense.

But, if one does take all 'causes' in Aristotle--and particularly the 'final cause'--to be in some sense 'efficient causes', those which actively produce an object or an event, there may indeed be some problem in establishing any positive evidence for, for example, a 'final cause' qua final as active in such production. And it is quite certain that this might seriously weaken some of Aristotle's own assertions and arguments, particularly against Democritus, against whom he levels the criticism a number of times that he neglected the 'final cause'. Not only that, but it would also seem to make Aristotle's criticisms at a number of places much less intelligible.

But Aristotle does indeed adduce positive evidence against Democritus, even when he criticizes him for neglecting

this 'final cause'; Aristotle never simply and arbitrarily says that Democritus was wrong in his assertions only because he had neglected it. But rather, Aristotle, as we shall see, does regularly claim that Democritus' neglect of a 'final cause' had seriously hampered his investigation, because it had led him to some doubtful conclusion or apparent error in some other respect, because it had led him to neglect some obvious and necessary factor in giving a fuller and more satisfactory explanation of the phenomenal world. Thus not only will the interpretation of 'final cause' as a factor in explanation be more firmly established in Democritus' case, but also Aristotle's arguments will not give the expected evidence of any noticeable weakness in this connection.

On the other hand, any argument which would hold against Democritus, establishing a material, formal, or final cause, qua material, formal, or final, as 'quasi-efficient' and active, will also hold a fortiori for 'cause' in the broader sense of 'explanatory factor'. Thus, in fact, the position of neither Aristotle nor Democritus is unnecessarily weakened by this approach and interpretation of the meaning of 'cause' in Aristotle. And, indeed, this promises to give a fairer treatment to the positions of both philosophers, and we shall be able to get down more efficiently to what is really at issue between them in this matter of 'causes'.

On the whole, Democritus' position on this issue of 'causes' is a purely mechanistic one: any object or event can

be explained simply and absolutely in terms of permanent atoms and void in a specific arrangement, which may be moved or changed only in a predetermined way when bombarded from the outside by another atom or set of atoms; this means, as we shall see upon closer examination, that there is in Democritus' teaching an accounting to some degree of material, formal, and efficient causation. This, Democritus is convinced, is the only type of explanation feasible or possible.

It is, on the contrary, Aristotle's position on this issue that this sort of explanation obviates and, indeed, denies not only an explanation by 'final cause', but also a more important distinction between 'artificial' and 'natural' objects. This latter distinction seems to Aristotle obvious enough, and he thus persistently tries to show how Democritus' theory falls short of accounting in this respect for the phenomenal world; and the reason for the deficiency in Democritus' theory is regularly that he did not explain things from a point of view of their 'natural development' and of their proper functioning and purpose.

Of the four 'causes' of Aristotle we have already considered in some detail the 'material cause' in chapters one and two; so not much more need be said about it. Thus, though we have already in fact touched on the matter of efficient and formal cause, these, along with the matter of the 'final cause' remain for fuller consideration. As was mentioned, it will be the contention of this section of this paper that

there are specific counterparts in Democritus' teaching to both efficient and formal causes; and to these, as we shall see, Aristotle objects on the grounds not only of their intrinsic inadequacy, but also of their failure to be supplemented by any analogue to 'final cause'.

Furthermore, the discussion of this chapter will also involve us in the question of what is meant in Democritus' teaching by 'necessity' and by 'chance', both of which, along with Aristotle's criticisms, will be seen to find their proper place within the question of causation.

The Formal Cause

The teachings of Democritus do evidently contain an accounting of physical objects which is analogous to Aristotle's 'formal cause'. Aristotle himself testifies to this fact on a number of occasions, all of which are aptly summarized in the Physics where Aristotle in a parenthetical remark says: "For to a certain extent Empedocles and Democritus touched slightly on the matter of form and essence."⁷ And to further assure ourselves that this is really the intention of Aristotle, he uses terms which are for him technical phrases for 'form' and 'essence': τὸ εἶδος (Physics 2.2, 194a21), τὸ τί ἦν εἶναι (Physics 2.2, 194a21; Part. Anim. 1.1, 642a26), and τὸ ὁρίσασθαι τὴν οὐσίαν (Part. Anim. 1.1, 642a26; and this term

⁷Physics 2.2, 194a20-21: ἐπὶ μικρὸν γάρ τι μέρος Ἐμπεδοκλῆς καὶ Δημόκριτος τοῦ εἶδους καὶ τοῦ τί ἦν εἶναι ἤψαντο. The other passages in which this is said are Metaphysics 13.4, 1078b19-21 and On the Parts of Animals 1.1, 642a26-28.

seems to be the one implied in the passage at Metaphysics 13.4, 1078b19-21).

But there is some difficulty in determining the nature of Democritus' attempt to specify a 'formal cause' or 'define the essence of an object'. Ross, in his commentaries on the passages both in the Physics and in the Metaphysics, says nothing to indicate the nature of Democritus' attempt; but in his 'analysis' of the passage in the Metaphysics he does indicate that the attempt amounted to nothing more than Democritus' definition of heat and cold.⁸ Cherniss agrees.⁹ But it hardly seems appropriate to describe Democritus' account of heat and cold as a substantial contribution to the development of the concept of τὸ εἶδος, τὸ τί ἦν εἶναι, and τὸ ὁρίσασθαι τὴν οὐσίαν. Aristotle's use of these terms in describing the attempt leads one to expect more than that, in spite of the qualification ἐπὶ μικρόν.

Langerbeck, on the other hand, begins his consideration of the problem with the passage at On the Parts of Animals 1.1,¹⁰ but he does not see any real connection between this account and Democritus' teaching about atoms; it is only concerned, he says, with phenomena, and for this reason Democritus

⁸Ross, Metaphysics, II, 419. The text at Metaphysics 13.4, 1078b19-21 reads: ἐπὶ μικρόν Δημοκρίτος ἤψατο μόνον καὶ ὥριστό πως τὸ θερμὸν καὶ τὸ ψυχρόν. Under Ross' interpretation the first καὶ here is taken to be explanatory rather than conjunctive.

⁹Op. cit., p. 227, note 44.

¹⁰Op. cit., pp. 83-84.

had really failed to give the $\tau\acute{\iota}$ ἦν εἶναι. Democritus, Langerbeek further claims, was primarily interested in physical theory--atoms and void--and so did not pursue this matter of definition by appearance any further.¹¹ But this seems not to do sufficient justice either to Aristotle's witness to the unity of Democritus' account (περὶ πάντων ἐνὶ λόγῳ--Gen. et Corr. 1.8, 325a1) or to Aristotle's claim that Democritus did indeed touch on $\tau\acute{\iota}$ ἦν εἶναι (Part. Anim. 1.1, 642a26).

Thus neither of the above views on the 'touch on form' by Democritus is entirely satisfactory; the former, as was said, because it seems too limited and narrow to apply at all. And that this undue limitation of this view of 'definition' is even more suspect is supported by Aristotle's statement that Democritus' attempts at definitions applied to everything: ὁδῶ δὲ μάλιστα καὶ περὶ πάντων ἐνὶ λόγῳ διωρίσασι Λεύκιππος καὶ Δημόκριτος--Gen. et Corr. 1.8, 324b35-325a1.

It will be helpful to examine a little more closely the context in which the claim is made that Democritus 'touched on form', in order to see more clearly what Aristotle likely had reference to when he made that claim. First of all, in the passage just mentioned from On Generation and Corruption 1.8, Democritus' attempt is closely connected with that of Empedocles; and the link with Empedocles is reiterated in two of the

¹¹Ibid. "Da Demokrit nur das ποῖον nicht aber das $\tau\acute{\iota}$ bestimmt hat, hat er das Wesen, das $\tau\acute{\iota}$ ἦν εἶναι, eben verfehlt" (p. 84). "Aristoteles sieht bei Demokrit Ansätze zum ὁρίζεσθαι, die aber nicht durchgeführt sind--wohl weil Demokrit in der φυσικῇ θεωρίᾳ sein eigentliches Gebiet hat."

other passages in which Aristotle deals with the question.¹² One point of contrast between Empedocles and Democritus in this passage in On Generation and Corruption--emphasized by the μὲν . . . δὲ, is that Empedocles used his type of definition in a few cases, while Democritus is said to have done so for everything: οἱ μὲν οὖν ἐπὶ τινων . . . ὁδῷ δὲ μάλιστα καὶ περὶ πάντων . . . διωρίκασι . . . Δημόκριτος --324b32-325a1.

What then was the nature of Empedocles use of 'form'? Aristotle describes Empedocles use of it as more or less unintentional (αὐτῇ . . . περιπίπτει) in On the Parts of Animals 1.1, 642a18ff. And it is in this passage that an example of his 'definition' is described: it consisted of accounting for something by means of a ratio of mixture of specific elements (λόγος τῆς μίξεως αὐτῶν [στοιχείων]); and the specific example cited is that of the 'form of bone'.¹³ A specific ratio of mixture of various kinds of elements--this is precisely the kind of an account which we have seen that Democritus gave of some substances.¹⁴ Thus, if the link with Empedocles is as

¹²Both in Physics 2.2 and Part. Anim. 1.1. In the only other passage on this matter there is a reference to the Pythagoreans (Meta. 13.4).

¹³This is substantially repeated at Meta. 1.10, 993a18-22; and the precise formula for bone is given by Aristotle from Empedocles himself at Anim. 1.5, 410a1-6.

¹⁴The fact that Aristotle linked Democritus' attempt at form with the Pythagoreans (see note 12, above) is equally striking. If one were to transfer the Pythagorean numbers to (atomic) units, we get the same kind of attempt at 'defining form'.

significant as seems likely, the analogue to 'form' or 'essence' in the system of Democritus was an accounting of the various sized atoms which make up that object; and this is evidently what Aristotle recognized as 'form' in the teaching of Democritean atomism.

In spite of the earlier reluctant attempt of Empedocles at defining the form of bone, Aristotle describes Democritus' efforts in this regard as those of a pioneer: ἦψατο μὲν Δημόκριτος πρῶτος --Part. Anim. 1.1, 642a27. It may be well then to suggest a little more fully and clearly the steps forward which, from Aristotle's point of view, Democritus had taken in his 'touch on form and essence'.

One reason that Aristotle saw which brought about the ultimate failure of previous efforts to deal with form and essence was the inability of philosophers to make any real distinction between the essential form of an object and the contrary accidents which may at various times be true of it: διαλεκτική γὰρ ἰσχυρὸς οὕτω τότ' ἦν ὥστε δύνασθαι καὶ χωρὶς τοῦ τί ἐστὶ πάναντία ἐπισκοπεῖν --Meta. 13.4, 1078b25-26. But this is precisely the problem that Democritus had considered and attempted to solve by positing atoms and void as those things which truly exist, one as 'that which is' and the other as 'that which is not', and by making the appearance of contraries in the physical object due to shifts in the atoms.¹⁵ In this respect he had gone beyond Empedocles and might right-

¹⁵Meta. 4.5, 1009a27-30; Gen. et Corr. 1.2, 315b9-15.

ly be called a pioneer.

Furthermore, Empedocles--in contrast to Democritus--had only applied his definition to a limited number of objects (ἐνί τινων--Gen. et Corr. 1.8, 324b32), evidently because he had only hit upon it unintentionally (ἐνιαχοῦ . . . περι-πλπτει--Part. Anim. 1.1, 642a18);¹⁶ whereas Democritus' attempt was likely a conscious one and applied more consistently to a large number of objects (περὶ πάντων ἐνὶ λόγῳ--Gen. et Corr. 1.8, 325a1), even though it was not really essential to his physical theory (ὥς οὐκ ἀναγκαίου δὲ τῇ φυσικῇ θεωρίᾳ -- Part. Anim. 1.1, 642a27-28), likely, as we shall see, because it was not constant in the ever-changing structure of physical objects. Thus not only Democritus' attempt to deal with the basic problem of an object as distinct from its contraries, but also his conscious, consistent, and wide application of this kind of 'essence' justify the prominent place which Democritus has in this matter in Aristotle's eyes.

The broad scope of Democritus' attempt at definition is indicated in connection with his treatment of the 'traditional elements'. As we have already seen, Democritus had attempted to account for the mutual generation of the 'elements', and in so doing had evidently proposed a definition of those elements in terms of set ratios of atoms of specified sizes; a new element is formed by the addition or subtraction of atoms of a

¹⁶The instance of Empedocles' definition of bone seems to be unique, according to Meta. 1.10, 993a17-20, although Aristotle says that Empedocles would have applied it more widely.

specific size.¹⁷ Thus this definition of simple bodies and, by implication, more complex ones as well is in terms of certain proportions of atoms; and this is obviously the way in which Democritus defined what physical objects really are, that is, what their essential form is.

And this is evidently also the way in which he defined the essence of man according to Aristotle at On the Parts of Animals 1.1, 640b28-35; what is given is not simply a 'material explanation',¹⁸ but a 'formal' one--the whole point of the specific mention of Democritus' attempt being that he had indeed given more than a simply 'material explanation':

"For the nature of a physical object which takes account of the structure ($\mu\omicron\omicron\phi\eta$) is more essential than its material nature. And so, if every animal and each of their parts were determined by their outward shape and their coloration, Democritus would be right, for this is what he seems to suppose. At any rate, he says that it is evident to everyone what sort of a thing a man is as to his structure ($\mu\omicron\omicron\phi\eta$) inasmuch as he is known by his outward shape ($\sigma\chi\eta\mu\alpha$) and coloration."

Thus Democritus would say that a man's real atomic structure ($\mu\omicron\omicron\phi\eta$) can be determined by correspondence to the appearance

¹⁷See Caelo 3.4, 303a24-29; 3.7, 305b20-25. This matter is taken up in chapter three in the section on "The Structure of Physical Objects." This atomic structure, apparently simpler in the case of the 'elements', is thus evidently meant to apply to other objects as well, although in those cases the structure would obviously be more complex.

¹⁸Cherniss, op. cit., p. 259, apparently in this instance follows Langerbeck in seeing a definition in terms only of outward appearance and says that Aristotle's objection to it is that this is an aspect of 'material cause'. But Aristotle does not here raise this objection, whereas he does praise Democritus at the end of this chapter for his pioneer attempts at a formal cause; and this latter point seems decisive.

that he presents.

It seems evident from the above that the καὶ at Meta-physics 13.4, 1078b20 is not explanatory, but conjunctive; Democritus had touched on definition and 'formal cause' far beyond the scope of merely defining heat and cold.

Thus we may summarize in the following way what is in Democritus' teaching the analogue of 'essential form', that which Democritus used in giving explanations of objects as they essentially are, from the point of view of 'form', and so in giving 'formal causes'. The essential form for Democritus, that which indicates precisely 'what an object really is'--apart from what it appears to be--is a fixed ratio of atoms, with the size atom predominating determining more specifically its nature.

Aside from this Democritus is said to have defined after a fashion both 'what is hot' and 'what is cold'. 'What is hot' is likewise defined in terms of atoms, this time atoms of a specific geometrical figure--spherical atoms which produce in us the sensation of heat. But what is meant by a definition of 'what is cold' is a bit more obscure; Democritus evidently did not define it in terms of atoms of a specific geometrical figure, thus providing a definition in the same category as 'what is hot'.¹⁹ The only indication that we might have for such a definition--though it is highly conjectural--

¹⁹Compare Gen. et Corr. 1.8, 326a3-6, where Aristotle specifically notes Democritus' failure to do so in spite of 'hot' and 'cold' being contraries in the same set.

is to be found at On Generation and Corruption 1.9, 327a16-19, where Aristotle describes the same body being now liquid, now frozen solid (ὅτε μὲν ὑγρὸν ὅτε δὲ πεπηγός--327a17). If, as seems likely, the πεπηγός refers to ice, and cold is indeed to be connected with the 'contraction' which seems to take place,²⁰ then 'what is cold' is likely to have been defined by Democritus in terms of the arrangements of atoms in an object: οὐδὲ τροπῇ καὶ διαθιγῇ, καθάπερ λέγει Δημόκριτος -- 327a18-19.

Since this type of definition of the physical object's 'essential form' is made in terms of the real atomic structure of such objects, we have in fact already considered a number of Aristotle's criticisms of Democritus' theory of 'formal cause', when in the last chapter we considered the theory of the atomic structure of physical objects. To review them briefly, they are the following. 1) Such 'form' is inadequate because it denies in fact the real unity of physical objects; for example, in the last cited instance of 'definition' Aristotle objects on the grounds that "we see the same body as a continuum now liquid, now frozen solid" (ὁρῶμεν δὲ τὸ αὐτὸ σῶμα συνεχές ὃν ὅτε μὲν ὑγρὸν ὅτε δὲ πεπηγός).²¹ 2) Then there is the objection at Metaphysics 4.5 that such an 'essential form' leaves no persistent aspect of the physical object,

²⁰Guthrie, History, II, 441, indicates that there is a tradition for such a connection.

²¹Gen. et Corr. 1.9, 327a16-17.

because each minute change in the object makes it in fact a different object: ἔτι δ' ἀξιῶσομεν αὐτοὺς ὑπολαμβάνειν καὶ ἄλλην τινὰ οὐσίαν εἶναι τῶν ὄντων ἧ οὔτε κίνησις ὑπάρχει οὔτε φθορὰ οὔτε γένεσις τὸ παράπαν--1009a36-38. So on Democritus' theory to seek a permanent truth about a physical object would be like seeking something which is constantly fleeting: τὰ πετόμενα διώκειν--1009b39. 3) Finally, in the same chapter of the Metaphysics, by Democritus' view there would be no real way to know such a persistent truth or 'essential form' because only what is sensible really exists: τὰ δ' ὄντα ὑπέλαβον εἶναι τὰ αἰσθητὰ μόνον--1010a2-3. In these criticisms Aristotle's position seems certainly to be justified.

The second type of criticism which Aristotle levels against Democritus' theory of 'formal cause' is one apparently not leveled against Democritus' 'form' qua form, but one which is made on the grounds that it is inadequate and hence unsatisfactory because it is not related to an attempt to explain in terms of 'final cause'. Thus the basic charge made is that this sort of explanation is incomplete and misguided by the neglect of the 'final cause', that knowing what an object is for and what is its proper functioning does indeed contribute something substantial to our knowledge of that object. But since this type of criticism will be taken up in more detail in a separate section, it seems appropriate here simply to point out this sort of reaction on Aristotle's part as it occurs in contexts where Democritus' theory of 'formal cause'

is brought up as an issue.

First of all, in Physics 2.2, after mentioning Democritus' touching on the 'formal cause', Aristotle points out that aside from knowing the matter and the form, it is also the place of natural knowledge to know the purpose and end of any object: ἔτι τὸ οὐ ἔνεκα καὶ τὸ τέλος [γνωρίζειν] τῆς αὐτῆς [φυσικῆς ἐπιστήμης] (194a27-28), because artificial objects are used to some purpose and natural objects are in the process of development to some end and are indeed (or, have) an end in themselves: ἐσμέν γάρ πως καὶ ἡμεῖς τέλος --194a35.

Again, Democritus' attempt at 'form' is mentioned at Metaphysics 13.4, 1078b19-21, but there is here no immediate criticism or apparent reaction on Aristotle's part; but, though it is not specifically directed against Democritus, there may well be a reaction to his type of 'form' at Metaphysics 14.6, 1092b26-28: "What is the good when things are composed of numbers by the mixture being in a certain number, whether that number is calculable or a complex ratio?"²² Such an account of form has no account of the object's good, its usefulness for something, its proper function--and hence it is not an adequate account.

And finally, at On the Parts of Animals 1.1, Democritus' definition of form is again mentioned, and, where an instance is given of Democritus' application of form to physical objects, Aristotle criticizes it on the grounds that it fails to

²²τί τὸ εὖ ἐστὶ τὸ ἀπὸ τῶν ἀριθμῶν τῷ ἐν ἀριθμῷ εἶναι τὴν μίξιν ἢ ἐν εὐλογίστῳ ἢ ἐν περιττῷ;

consider the function of that object: οὐ γὰρ δυνήσεται ποιεῖν τὸ ἑαυτῆς ἔργον--641a2-3. Then later in this chapter, when Democritus' general attempt at 'form' is mentioned (642b26), Aristotle immediately points to the contribution of Socrates and his view of the 'useful excellence' (τὴν χρήσιμον ἀρετὴν --642b29) and the advantage of explaining things like respiration from the point of view of their purpose: δεικτέον δ' οὕτως, οἷον ὅτι ἔστι μὲν ἀναπνοὴ τοῦδὲ χάριν --642b31-32.

The Efficient Cause

The account which Democritus gives of 'efficient causation' is really quite clear and consistent; it is all reduced to a mechanical, forced locomotion--one atom or set of atoms in motion strikes another atom or set of atoms, and this induces in the latter either a movement or a new movement in the void.

Since the atoms of Democritus are not capable of being affected in themselves, they are only subject to change of place; and so all real motion such as change, increase and decrease, generation and corruption are reduced to a matter of the locomotion of atoms. This, Aristotle rightly recognizes in a passage in the Physics; though the passage does not mention the atomists specifically, it obviously refers to them.²³

²³Physics 8.9, 265b23-29. Motion is explained by these men in terms of the void (διὰ τὸ κενόν--265b26) and the movement is that of atomic bodies (τῶν ἀτόμων σωμάτων--265b29). Simplicius, In Physicorum, p. 1318, line 32, describes them as the 'school of Democritus'--οἱ περὶ Δημόκριτον.

These atomists, Aristotle points out, claim that the only real motion that takes place is locomotion, movement in place:

οὗτοι τὴν κατὰ τόπον κίνησιν κινεῖσθαι τὴν φύσιν λέγουσιν
(265b25); all other types of motion are reduced in reality to locomotion of atomic bodies: "They suppose that none of the other types of motion are properties of their primary atomic bodies, but are only connected with those objects which are composed of these atoms, for they say that increase, decrease, and alteration occur when atomic bodies join and disperse"--265b27-29.

This means, furthermore, that all accounts of motion are accounts of 'forced' motion in the strict sense; there is in Democritus no natural motion of atoms, as there is a primeval and primary 'down-ward rain of atoms' in the systems of Epicurus and Lucretius. In spite of the fact that Democritus' atoms have weight, their weight in the vast, directionless, infinite expanse of void does not give them a 'natural motion' in some direction (Physics 4.8, 215a8-9) in and of themselves. They are in fact under the influence of 'forced motion', with 'squeezing out' (ἐκθλιβόμενον--Caelo 4.2, 310a10) describing not only their accounts of upward motion, but also such physical processes as breathing (Resp. 4); one atom is only affected in that it is struck by another: ἄλλο ὑπ' ἄλλου κινεῖται βίη τῶν στοιχείων--Caelo 3.2, 300b11-12.

And this sort of mechanical, forced locomotion is held by Democritus to apply consistently at all levels of complex-

ity of structure; and it is in his view the only one which really applies as an efficient cause.

This is most obviously true at the level of the individual atom, as Aristotle points out, for example, at On Generation and Corruption 1.8; an atom has no absolute heaviness or lightness as an inherent property (βαρύτης δὲ καὶ κουφότης . . . μὴ ὑπάρξει:--326a7-8), and hence no natural upward or downward motion; it likewise has no hardness or softness so as to be inherently affected (326a8); it is indeed unable to be affected (ἀπαθὲς) apart from the fact that its locomotion can be changed. Any action and passion that occurs on this level occurs by contact,²⁴ and is thus a 'forced', mechanical change of motion.

It applies as well to such physical objects as complex as human beings. Democritus had said, according to Aristotle at On the Soul 1.3, 406b15-22, that the soul's own motion and its setting the body into motion are to be described in such terms of mechanical, forced motion, much like the wooden statue of Venus is said to have been given movement: the spherical atoms in locomotion drag the whole body with it and thus set it in motion.²⁵

There are, furthermore, a whole series of natural processes which Democritus described as being caused precisely in

²⁴Gen. et Corr. 1.8, 325a32-33: ποιεῖν δὲ καὶ πάσχειν ἢ τυγχάνουσιν ἀπτόμενα.

²⁵406b20-22: κινουμένας γάρ φησι τὰς ἀδιαιρέτους σφαῖρας . . . συνεφέλκειν καὶ κινεῖν τὸ σῶμα πᾶν.

this way. All the way from conception and the cradle to their death animate creature and the natural processes that take place in them are described by Democritus in terms of such mechanical and artificial efficient causes reminiscent of the 'wooden statue of Venus' at On the Soul 1.3, "just as if they were animals made of wood or stone" (ὥσπερ ξυλίνων ἢ λιθίνων ζώων--Gen. Anim. 2.4, 740a15-16).

And Aristotle also says in the same chapter (Gen. Anim. 2.4, 740a36-38) that Democritus claims that the foetus stays in the womb because there its parts are mechanically formed and modeled (διαπλάττηται--740a38) after the corresponding parts of its mother.²⁶

Later in the same work, at On the Generation of Animals 4.3-4, Aristotle cites explanations in the area of genetic development which are likewise described in this same mechanistic way. First of all, in the latter portion of book four, chapter three of this work Aristotle describes a theory which he fails to identify specifically with any individual; it is an explanation in terms of πανσπερμία, which most probably be-

²⁶Cherniss, op. cit., p. 288, note 255, conjectures--on the grounds that Aetius, Placita 5.16.1, says that Democritus claimed that the foetus is nourished in the womb--that what Democritus likely really said was that the foetus merely required food derived from its mother that it may grow into human form. But this interpretation is only a supposition on Cherniss' part; the citation from Aetius in itself does not justify Cherniss' interpretation of Aristotle; and Aristotle's statement is quite clear and is not at all inconsistent with that of Aetius--the specific food that the foetus gets from its mother as nourishment might very well determine mechanically the way in which it develops.

longs to Democritus.²⁷ The term πανοπερμία certainly seems strongly to suggest Democritus, and so does the context. At 769a17-20 Empedocles and Democritus are distinguished from those who cannot in principle show why a daughter may in certain respects take after her father; and one type of explanation which can account for such genetic developments is the one in which the semen from which the child develops is described as a πανοπερμία (769a26-29). This account, Aristotle says, seems quite artificial (πλασματίας--769b1), a remark which is certainly reminiscent of what Aristotle had said about Democritus' reason for the foetus staying in the womb (διαπλάττηται). This theory, Aristotle continues (769b3-10), though complex, does attempt to explain a number of genetic developments; and the last on the list which this theory explains is the reason for monstrosities. Then, after an explanation of what is meant by 'monstrosities', the first theory which Aristotle mentions is that of Democritus--4.4, 769b33ff. All of these factors seem to make it highly likely that the theory of πανοπερμία here in question is indeed that of Democritus.

This theory of πανοπερμία explains family resemblances to either father, mother, or more remote ancestors by taking the semen to be a 'seed-mixture' of great variety (πανοπερμίαν εἶναι τινα πολλῶν--769a29); the semen is thus a random sampling

²⁷Cherniss, op. cit., p. 284, note 243, denies that it belongs to Democritus and would rather attribute it to Plato.

of a large variety of ingredients (769a31-34); and the offspring's (atomic) structure resembles that of the ancestor from whom the largest proportion of ingredients was derived: ἀφ' οὗ γὰρ ἀν τῶν γεννώντων πλεῖστον ἐγγένηται τοῦτω γίνεσθαι τὴν μορφήν ὁμοίως--769a34-36. Just as the predominance of atoms of a certain size determines the nature of the element, so the predominance of seeds of a given kind in a certain proportion determines the nature of certain features of the offspring²⁸--and the explanation is purely mechanical.

And Democritus' explanation of 'monstrosities' is equally mechanical; it is now taken up at the beginning of On the Generation of Animals 4.4, at 769b32ff. Such monstrosities, in Democritus' view, are the result of two copulations; when the foetus has begun to develop as a result of the first copulation, the semen from the second comes and joins with it, and some parts of the body are thus fused and altered.²⁹ The efficient cause in this instance is again external and mechanical.

²⁸The constituents of the semen represent constituents from each part of the body (compare Gen. Anim. 4.1, 764a6-11) and so it is likely that the nature of each part of the body is determined by the predominance of a specific kind of atom in that part. And, since both parents contribute materially to the offspring, Democritus can thus explain why this offspring can resemble one parent in one respect and another in another respect.

²⁹The text seems corrupt here, but the sense of the passage is clear enough. This citation certainly supports the view of the mechanical formation in the womb as described at Gen. Anim. 2.4; if the foetus were thought to have an internal principle of development, it is not likely to be affected by the semen of a second copulation.

Once more in On the Generation of Animals Aristotle cites a further instance of this type of explanation by Democritus. The matter under discussion is the 'falling out' of front teeth in animate creatures. Aristotle cites Democritus' remarks on the subject (Gen. Anim. 5.8, 788b12-14) as follows: these teeth grow prematurely, and the explanation which Democritus gives for this is an external efficient cause--the suckling of the offspring is the cause of it (τὸ θηλάζειν αἰτίαται--788b14); and this early growth of these teeth--a growth which was mechanistically induced--is also the reason for their 'falling out': ἐκπίπτειν μὲν διὰ τὸ πρὸ ὥρας γίνεσθαι (788b12).

And this same sort of explanation is seen too in Democritus' account of breathing, which we have already outlined in connection with his theory of the soul; this account is found most fully at On Respiration 4, 471b30-472a16. The efficient cause of breathing, according to Democritus in Aristotle's account, is external pressure from the environmental air: συγκρινομένων οὖν αὐτῶν ὑπὸ τοῦ περιέχοντος ἐκθλίβοντος.³⁰ Thus the entire process of breathing in and out is described in terms of pressure, relief of pressure by the counter-pressure of the spherical atoms which enter, and then again by the external pressure from the air.

Furthermore, in this same context Aristotle gives witness

³⁰472a5-6; see also Aristotle's remark on this at 472a23-24: ἔσωθεν ἡ ἀρχὴ τῆς ἀναπνοῆς γίνεται καὶ τῆς κινήσεως οὐχ ὥς βιάζομένου τοῦ περιέχοντος.

to a similar, utterly mechanistical explanation of death (742a12-16) by Democritus. Death, according to Democritus, occurs when this dynamic equilibrium between pressure and counter-pressure fails, when the pressure of the environmental air gains the mastery (ὅταν γὰρ κρατῇ τὸ περιέχον συνθλίβον -- 472a12) and such soul-atoms which were once useful in maintaining the counter-pressure are squeezed out.

So in the system of Democritus not only the atoms, the elements, and inanimate objects are subject to only a 'forced', mechanistic efficient cause, but so too are animate creatures. From the cradle to the grave even human beings are subject to it alone--so consistently and persistently did Democritus apply this manner of explanation in terms of 'efficient cause'.

But not only does Democritus say that this is the kind of explanation which applies now, but it has also applied from eternity. For time, Democritus claims, is ungenerated; it always was: τὸν γὰρ χρόνον ἀγέννητον εἶναι -- Physics 8.1, 251b17. And so, although the phenomenal objects of this world are seen to come and go--to come into existence and to pass out of existence--this cannot be so in the case of all things; there must be some things which did not come into existence: διὰ τοῦτο Δημόκριτος γε δείκνυσιν ὡς ἀδύνατον ἅπαντα γεγονέναι -- 251b15-17. And these 'ungenerated things'--existing from all eternity--are evidently Democritus' atoms; and their reaction on impact under the same circumstances has always been the same. And it is to this principle that Democritus refers

the causes of natural objects: ἐφ' ὃ Δημόκριτος ἀνάγει τὰς περὶ φύσεως αἰτίας, ὥς οὕτω καὶ τὸ πρότερον ἐγίνετο --252a34-35. What is happening now on the real, atomic level has been happening from eternity--this same mechanistic, forced motion: any time combination A of atoms collides in a given way with combination B, C always has resulted.

This system of explanation does indeed go back to infinity; there is according to Democritus no prior efficient cause of this motion of the atoms--none like the νοῦς of Anaxagoras or like 'Love' and 'Strife' in Empedocles system: τοιαύτην μὲν οὐδεμίαν αἰτίαν--Physics 8.9, 265b23-24. There is in this system no original source of the mechanical motion of the atoms, and the remark of Aristotle at Metaphysics 1.4, 985b19-20 does in this sense apply to Democritus: the atomists neglected the question of the source of motion.³¹

This statement about neglect of a primary efficient cause is taken up again by Aristotle at On the Heavens 3.2; and this deliberate neglect means, as Aristotle there points out and as Democritus was evidently aware, that, since all movement is forced, there is an infinite regress in looking for the primary efficient cause: A's movement was caused by B's, which in turn was caused by C's . . . ad infinitum: εἰς

³¹The significance of this statement of Aristotle--περὶ δὲ κινήσεως ὅθεν . . . ὑπάρξει τοῖς οὖσι . . . ἀφείσαν--I believe is broader and, as we shall see, will apply to Democritus' failure to distinguish natural from artificial objects; the former have their source of motion internal to them, and the latter have it external to them.

ἄπειρον γὰρ εἶσιν, εἰ μὴ τι ἔσται κατὰ φύσιν κινεῖν πρῶτον,
 ἀλλ' ἀεὶ τὸ πρότερον βίη κινούμενον κινήσει --Caelo 3.2,
 300b14-16.

This means in turn that this series of forced movements is 'natural' (with a meaning which for Aristotle is somewhat broader than his own); that is, he recognizes it in Democritus' system as that which is analogous to his own use of 'natural'. He says at On the Heavens 3.2, 301a7-9: "for the 'natural' state of affairs is that which most objects have over the majority of time." Thus for Democritus--as paradoxical as it sounds in Aristotle's terms--the 'natural' kind of motion is 'forced' motion; and there is thus in fact no distinction at all between natural and forced motion.

We have already touched to a certain extent on Aristotle's criticism of forced motion in Democritus--and thus on the efficient cause in Democritus--in the second chapter in connection with the void. It will thus be appropriate here simply to recapitulate some of the objections which we have seen that Aristotle had already raised against this kind of an account of efficient cause and then proceed to further criticisms of his particularly in terms of the efficient cause in animate objects.

First of all, Aristotle points out that a theory like that of Democritus, which recognizes only forced motion and takes no account of its sources, offers in fact no rational explanation of the motion in the universe. With an infinite

number of movents, there will also be an infinite number of motions, as Aristotle points out at On the Heavens 3.2, 300b34-301a1: εἰ δ' ἄπειρα τὰ κινούμενα, καὶ τὰς φορὰς ἀναγκαῖον ἀπείρους εἶναι. This is--inasmuch as an infinity is involved--in principle unintelligible and irrational; it amounts to a claim for disorderly motion over an infinite period of time. Thus, in this respect, a primary movent like the of Anaxagoras is more appropriate to the order that we see in the universe: ἔοικε δὲ τοῦτό γε αὐτὸ καλῶς Ἀναξαγόρας λαβεῖν· ἐξ ἀκινήτων γὰρ ἄρχεται κοσμοποιεῖν --301a12-13.³² The idea of κόσμος in κοσμοποιεῖν is important, for we do see orderliness of motion in the universe; and this orderliness manifests itself, for one thing, in natural motion: τὰ μὲν βάρος ἔχοντα ἐπὶ τὸ μέσον, τὰ δὲ κουφότητα ἀπὸ τοῦ μέσου· ταύτην δ' ὁ κόσμος ἔχει τὴν διάστασιν --300b24-26. We see ordered and natural motion, but Democritus posited disorder and forced motion as the only motion there is; and so Democritus' explanation has less basis in empirical evidence than that of Aristotle.

Leucippus (and hence also Democritus) is said to have posited motion as an eternal activity (Meta. 12.6, 1071b32--ἀεὶ ἐνέργειαν), but does not explain motion: ἀλλὰ διὰ τί καὶ τίνα οὐ λέγουσιν, οὐδ', εἰ ὡδὲ ἢ ὡδί, τὴν αἰτίαν --1071b33--

³²This is brought up again by Aristotle at Metaphysics 1.4, 985a18-b2, b19-20. The contrast with Empedocles and Anaxagoras is taken up in the remark toward the end of the chapter in regard to the atomists: περὶ δὲ κινήσεως ὅθεν . . . ὑπάρξει τοῖς οὐσι.

34. But Aristotle objects that motion is not simply random: οὐδὲν γὰρ ὡς ἔτυχε κινεῖται --1071b34-35; but it does indeed show some distinction--and precisely a distinction between natural and forced motion: ὥσπερ νῦν φύσει μὲν ὁδός, βίη δὲ ἡ ὑπὸ νοῦ ἢ ἄλλου ὁδός--1071b35-36. We have already cited Aristotle's evidence for such a distinction; it is to be found, for example, at On the Heavens 4.2 and at Physics 4.8. In the former passage it will be recalled that Democritus' theory of atomic immutables and absolute void cannot in principle account for the obvious natural movements of the traditional elements, either in terms of proportions of solids or in terms of proportions of void in the object under consideration.³³ At Physics 4.8 the objection is raised that a thrown object will display characteristics of both natural and forced motion: a higher rate of speed if the forced motion is in the same direction as the natural motion, and an increasing take-over by natural motion when it is not thrown in the same direction as its natural motion (215a14-17).

But the evidence thus far adduced by Aristotle has been related to inanimate objects and elements; but there is a further and more particular issue on the matter of the efficient cause involved in the case of animate creatures. These more obviously and more uniquely have their principle of movement,

³³See especially Caelo 4.2, 309a2-18. Even the mechanistic explanation of 'squeezing out' (ἐκθλιβόμενον) is seen to be obviously unsatisfactory, for it means that a large quantity of air will be heavier than a small quantity of earth; and this is contrary to available evidence--310a10-13.

their immediate efficient cause, within themselves--whether this be of mere growth, of locomotion, or of rational and ethical activity. But the consistent and mechanistic system of Democritus seems regularly to deny this, since his explanation of efficient causality seems to operate primarily as something external even to animate creatures. And herein lies a fundamental point of issue between Democritus and Aristotle.

In the first place there seems to be some real evidence, Aristotle claims, to indicate that for animate creatures an external and purely mechanistic efficient cause is not an adequate explanation of some events and processes which occur in them. This Aristotle points out in two separate but related instances at On the Generation of Animals 2.4; there in the latter part of the chapter the matter under discussion is the development of the embryo in the womb.

The order in which the parts of the embryo are formed Aristotle sees as important, for the development is obviously a natural process with an internal principle of developmental formation into something specific. Democritus had, he says, wrongly held that the external portions of an embryonic animal are formed first, and the internal portions only later: ὥστερ Δημόκριτος, τὰ ἔξω πρῶτον διακρίνεσθαι τῶν ζῴων, ὥστερον δὲ τὰ ἐντός -740a13-14. But Aristotle objects that animals evidently have an internal principle of development; and that principle of development Aristotle sees as supplied by the heart or--in the case of bloodless creatures--its counterpart

in them.³⁴ But not only does reason demand that some internal principle be the first formed--because this internal principle is what distinguishes it as a natural object--but this development of the heart first is also substantiated by empirical fact: διὸ ἀποκρίνεται πρῶτον ἡ καρδία ἐνεργείῃ. καὶ τοῦτο οὐ μόνον ἐπὶ τῆς αἰσθήσεως ὁῦλον . . . ἀλλὰ καὶ ἐπὶ τοῦ λόγου --740a3-5. Thus Democritus, he justifiably claims, is wrong not only in principle, but also in fact; Democritus' mistaken principle, Aristotle would claim, had led him to make a statement which upon closer examination is contradicted by fact.

Aristotle again raises a similar objection a little later in this same chapter. Democritus, as we have seen (740a36-38), had claimed that the embryo stays in the womb because there it has its parts mechanistically molded to resemble its mother. This again is a denial of an internal principle of the development of the embryo, and, furthermore, it runs counter to another piece of empirical evidence (φανερὸν --740b1): animals produced in eggs have their parts developed inside the egg quite apart from the direct mechanistic influence of their mothers (740b1-3). Thus in these two respects Democritus' system of explanation by efficient cause in the case of animals is directly contradicted by empirical evidence. Evidently then both in principle and in fact there is likely something wrong

³⁴740a17-18: τὰ μὲν γὰρ τοιαῦτ' οὐχ ἔχει ἀρχὴν ὅλως, τὰ δὲ ζῷα πάντ' ἔχει καὶ ἐντὸς ἔχει. διὸ πρῶτον ἡ καρδία φαίνεται διωρισμένη πᾶσι τοῖς ἐναίμοις. Similarly at Gen. Anim. 2.6, 742b35-38; one might note here that in the animal realm this is a question of ὅθεν ἡ κίνησις ἐστίν.

with this sort of explanation.

Again roughly the same sort of criticism is raised by Aristotle at On the Generation of Animals 4.4 against Democritus' account of the development of monstrosities. Democritus had chosen to name the male sperm from a second copulation as the external efficient cause of monstrosities. But, Aristotle retorts, such monstrosities seldom occur in the case of animals that produce only one offspring at a time and are much more frequent in animals that produce a number of offspring at a time--and that from one semen and one copulation: ἐξ ἑνὸς σπέρματος πλείω γίνεσθαι καὶ μιᾶς συνουσίας --770a1. Thus, Aristotle says, it seems preferable to suppose an internal cause for the developing of the foetus also when monstrosities occur: ὅλως δὲ μᾶλλον τὴν αἰτίαν οἰητέον ἐν τῇ ὕλῃ καὶ τοῖς συνισταμένοις κυήμασιν εἶναι --770a6-7.³⁵ Furthermore, when conjoined fetations do occur--as in twin eggs--these frequently develop into separate chicks and grow quite normally, while a single fetation in an egg still does at times develop as a monstrosity (770a14-24).

And finally, there is a similar neglect on Democritus' part with respect to the cause of death. There is an obvious distinction between dying naturally of old age and dying con-

³⁵Cherniss, op. cit., p. 285, claims that Aristotle's objection is that this theory makes the male sperm responsible for imperfection. Aristotle does not, however, see this objection as the most basic one; but it is considered because it raises the larger issue of an internal principle of development and because the evidence points to the likelihood that the cause is elsewhere than external.

trary to nature by force. Yet Democritus' account fails to recognize this obvious distinction (Resp. 4, 472a17-23); but he certainly ought to have made this distinction, for this is most precisely a matter of whether the cause is external or internal: πότερον ἔσωθεν ἢ ἐντὸς --472a22.

In the above instances as well as in a number of others, as Aristotle sees it, Democritus' type of purely mechanistic explanation, relying on external efficient causes as it does, seems to run into a 'dead end', seems to reach a point beyond which it is unable to offer explanations. This limitation seems greatest of all when it comes to explanations of natural physical objects--plants, animals, and the like--for not only does Democritus fail in principle to present a real distinction between natural and artificial objects, but also one meets here in the realm of natural objects an extremely large variety of genera and species--most of them with a part or parts of their bodies which are similar in some respects, but not identical, to those of other species and each with somewhat unique functions of their parts relative to the functioning of the whole animate creature in question. And the explanation of these creatures and their parts in terms of function and purpose seems to Aristotle to open up this 'dead end', to offer opportunities for explanation which were not possible for Democritus. Hence it seems to Aristotle that any attempt to explain things--particularly in regard to animate creatures--which does not use purpose and function as explanatory

factors is unduly limiting itself in its attempt to make nature more intelligible to us. So on these grounds too Democritus' type of explanation by 'efficient cause' is inadequate; but such further inadequacies due to a neglect of purpose and functioning will be taken up more properly in connection with a separate section on the 'final cause'.

Thus Aristotle's criticisms of Democritus' 'efficient cause' are in summary that Democritus' system of explanation offers in fact no rational explanation of the motion in the universe, that it fails to recognize an obvious distinction between natural and forced motion, and that in animate creatures it persists in failing to use an internal efficient cause which is evidently that which marks them off from non-natural objects. And finally, Democritus' system of explanation unduly limits itself by not considering the function and purpose of an object or a process in connection with 'efficient cause'; indeed, most of Aristotle's criticisms of Democritus' accounts of 'efficient cause' in animals are raised in conjunction with an insistence on the importance of considering the 'final cause' along with it.

Chance and Necessity

Closely related to Democritus' teaching on 'efficient cause' is his teaching on 'necessity', for it is the motion and impact of the atoms on one another and the mechanical reaction of those atoms which are most precisely described by Democritus as being 'necessary'. Goedeckemeyer rightly dis-

tinguishes three kinds of contexts in which 'necessary' is used in reference to the teachings of Democritus: the mechanism of atomic impact, an eternal and indeterminate necessity, and the necessity of the primeval whirl.³⁶ And these three types of usage of the term 'necessary', though distinguishable in thought, are interrelated and are consistent parts of the same teaching.

In this regard Democritus' general principle is formulated by Aristotle at Physics 8.1, 252a32-33 as "it is a sufficient principle if something either always exists in a certain way or always happens in a certain way" (ἀρχὴν εἶναι ταύτην ἱκανήν, ὅτι ἀεὶ ἢ ἔστιν οὕτως ἢ γίγνεται);³⁷ thus, if atoms and void and motion are eternal, they are simply and absolutely necessary; one does not and ought not seek a further principle for them. And the same is true of the mechanical impact and reaction of atoms (under the same circumstances they always happen the same way); this too is simply and absolutely necessary. And, furthermore, Aristotle claims that Democritus also refers his explanations concerning nature to this principle: ἐφ' ὃ Δημόκριτος ἀνάγει τὰς περὶ φύσεως αἰτίδας--252a23. So, since the phenomena which we observe are

³⁶Albert Goedeckemeyer, Epikurs Verhältnis zu Demokrit in der Naturphilosophie (Strassburg: Karl J. Trübner, 1897), pp. 32-34. He cites for each of these respectively Aetius, Placita 1.26.2, Aristotle, Gen. Anim. 2.6, 742b17, and Diogenes Laertius 9.45.

³⁷This passage does not contain the term 'necessary', but for a similar statement of principle in which the term is used see Gen. Anim. 2.6, 742b17ff.

in truth nothing but atoms moving mechanically in a certain way in the void, phenomenal objects and processes obey the same law of necessity; the fact that a given phenomenon has occurred in a certain way under a specific set of circumstances in the past is a sufficient principle for establishing its necessity: ὡς οὕτω καὶ τὸ πρότερον ἐγένετο --252a35.

But we need to examine some of the more specific evidence in the light of this general statement of principle. Among those things which in Democritus' theory are necessary is the motion of the atoms in the void; indeed, Democritus' claim for the simple and absolute necessity of that motion provides the reason for Aristotle's having mentioned Democritus' general principle in the first place at Physics 8.1; this is the subject-matter of the entire chapter--the question of the eternity of motion. And motion is for Democritus eternal, but, unlike Empedocles and Anaxagoras, he refused to attempt to explain it; it is one of those things which simply always is, and any attempt to trace any particular motion of an atom or the motion of all the atoms back to a beginning leads only to a prior motion and impact of the same kind, and this again to another of the same kind ad infinitum.³⁸

Thus a further simple and absolute necessity is the law of motion which mechanically governs the atoms. And this is what is described by Aetius in the Placita 1.26.2: τὴν ἀντι-

³⁸ See the discussion of this above in this chapter at pages 285ff.; see also Caelo 3.2, 300b15-17.

τυπίαν καὶ φορὰν καὶ πληγὴν τῆς ὕλης --"the rebound, motion, and impact of the atoms." If this means anything at all, it means that for any atom A which strikes atom B in a certain way, a distinct and fixed kind of motion results; and this is equally true for groups of atoms, whether simple or complex. This endless series of motions and derived motions operates under fixed mechanical laws which are described as absolutely necessary; they are the ultimate and fundamental laws of nature; they are simply given as a first principle, and there is no further reason for or explanation of them.

Now this absolute and fundamental atomic necessity manifests itself in phenomena and in the observable processes of nature, for it is to this absolute principle of atomic necessity that Democritus refers his explanations about nature (Physics 8.1, 252a34-35). These natural phenomenal processes are evidently true representations of the processes on the atomic level, and so display an equally valid necessity; this is a direct corollary to the 'truth by correspondence' theory: just as the phenomenal object is a true representation of the object as atomically structured, so phenomenal processes are true representations of atomic processes of movement.

This means, furthermore, that the other parts of the general principle on atomic explanation ought to hold as well on the phenomenal level of explanation. One arrives at such necessity on the phenomenal level by observing a number of regularly occurring instances of the same phenomenal process;

and when a given process occurs with sufficient and consistent regularity, this may be taken as necessary, for it simply always happens in this way.³⁹ In these cases one ought to look no further for an explanation, because, as Democritus says, the instances of this process are limitless and indeterminate: "the number of instances of what always happens is limitless, and to ask for a reason for such things is to seek a principle for what is limitless (and so indeterminate)."⁴⁰ It is in this way that on the phenomenal level one arrives at an ultimate and universal law of nature--something which is simply 'necessary'.

And it is thus quite likely that all of Democritus' explanations of natural processes--where they could indeed be reduced to such a law of nature--were precisely of this kind. Aristotle cites at least two such instances where such explanations were intended to be of a universal character. In the first such citation Democritus is said to have explained the sterility of mules on the grounds that the mules' genital

³⁹"It regularly happened so in the past"--οὕτω καὶ τὸ πρότερον ἐγίγνετο (Physics 8.1, 262a35). ἀνάγκη . . . ὅτι οὕτως αἰεὶ γίνεται --Gen. Anim. 2.6, 742b19.

⁴⁰τὸ δ' αἰεὶ ἀπείρον, ὥστε τὸ ἐρωτᾶν τὸ διὰ τί περὶ τῶν τοιούτων τινὸς τὸ ζητεῖν εἶναι φησὶ τοῦ ἀπείρου ἀρχὴν --Gen. Anim. 2.6, 742b22-24. It seems evident that ἀρχὴ here does not mean 'beginning', but 'principle'; the former meaning would make nonsense of Aristotle's retort that in the instance of a triangle there is some 'principle' and reason for its having its angles equal to two right angles. Cherniss, op. cit., p. 179, note 146, feels that Aristotle is tampering with Democritus' meaning of αἰεὶ. But there is no real reason to suppose this.

passages were destroyed by the joining of two animals of different species (Gen. Anim. 2.8, 747a30-32). And this explanation Aristotle specifically says was meant to be a universal one (ἐπὶ πάντων--747a28). And again at On the Generation of Animals 5.8, 788b12-14 Democritus is said to have claimed that suckling causes the front teeth to develop prematurely and hence later to drop out; and this too was a universal statement: καθόλου λέγει τὴν αἰτίαν--788b12. And beside these, it is implied at On the Generation of Animals 2.6 that Democritus' account of the progressive development of the foetus was this sort of an explanation. Democritus is said to have held that the external parts of animals develop first,⁴¹ and then several lines later (740a36-38) Aristotle notes that according to Democritus the embryo stays in the womb in order to be mechanically formed like the mother; and finally at 2.6, where the matter of the development of the foetus is still under discussion, Aristotle raises the question of Democritus' principle about explanation of things which always happen in a certain way (742b17ff.). Thus it is certainly strongly implied that all of Democritus' explanations of the development in the womb of the mother were precisely of this nature--a universal law of nature on the phenomenal level.

Finally, the cosmic whirl (δίνη) as a necessity referred to by Diogenes Laertius at 9.45 is a special case. It is quite

⁴¹Gen. Anim. 2.4, 740a13-15; Aristotle remarks that this leaves them with no internal principle of development, and this is the error of Democritus' 'necessity' at 2.6, 742b34-38.

likely that it was described by Democritus as 'being the result of chance', and so the matter will be taken up shortly in connection with a discussion of 'chance' in the teaching of Democritus. But, to anticipate slightly, there is no reason to believe that it was any exception to the utterly mechanical laws of impact and rebound of the atoms. And if that law holds, then this universe, according to Democritus, is and was and evermore shall be from the lowest rock to the highest creature an unbelievably complex machine-like structure, a perpetual motion machine. And this is indeed the tenor of Democritus' teaching on necessity; and this is precisely the way in which Plutarch summarizes it: ἐξ ἀπείρου χρόνου προκατέχεσθαι τῇ ἀνάγκῃ πάνθ' ἁπλῶς τὰ γεγονότα καὶ ἔόντα καὶ ἐσόμενα .⁴²

Now Aristotle's criticisms of Democritus' teachings on necessity are quite clear and hardly very complex. First of all, Democritus had claimed to be giving universal explanations, but for those examples of universal explanation cited the facts do not warrent the claim for universality. Democritus had apparently made the claim universal that animals develop their external parts first. And Aristotle's response to this is that it just is not factual, for empirical evidence tells us that the heart is the first part which becomes distinct: διὸ ἀποκρίνεται πρῶτον ἡ καρδία ἐνεργείῃ. καὶ τοῦτο οὐ μόνον ἐπὶ τῆς αἰσθήσεως δῆλον --Gen. Anim. 2.4, 740a3-5.

⁴²[Plutarch], Stromateis 7 (Diels-Kranz 68A39).

Again Democritus made a universal statement about animals cross-bred between different species being sterile; and Aristotle's reply is again that this is simply not the case; other animals beside mules cross-breed between species, and yet their offspring do in fact produce progeny: συμβαίνει δ' ἐφ' ἑτέρων ζώων τοῦτο μὲν ὑπάρχειν, γεννᾶν δὲ μηδὲν ἥτιον -- Gen. Anim. 2.8, 747a33-34. And once more Democritus had made a universal statement about the mechanical development and later dropping of front teeth; and again Aristotle's counter-claim is that Democritus had simply not considered all or enough cases (οὐ γὰρ ἐπὶ πάντων σκεψάμενος --788b11); Aristotle then simply goes on and cites a number of cases in which Democritus' claim just does not hold true. Thus in general Democritus' mistake in this respect lay precisely in that he had made universal statements which were simply not universally true: τοῦτο μὲν οὖν ἡμαρτε καθόλου λέγων, οὐ σκεψάμενος τὸ συμβαῖνον ἐπὶ πάντων --788b17-18.

In the second place, Aristotle says, Democritus' very principle of necessity is itself a categorical statement: there is no further explanation beyond the fact that something either always is or always occurs in a certain way. But Aristotle on two separate occasions shows that this very categorical statement is not universally true.⁴³ In both instances Aristotle cites propositions from geometry--the angles of a

⁴³Physics 8.1, 252a35-b5; see especially 252b1-2: ὅτι δ' ἐπὶ πάντων, οὐκ ὁρθῶς. Also Gen. Anim. 2.6, 742b24-30.

triangle equal two right angles, and the side of a square and its diagonal are incommensurate--which are always true and for which there is a reason, an explanation, and demonstration.

And, lastly, at On the Parts of Animals 1.1, 642a31ff., as Democritus' theory and meaning of 'what is' and 'what is not' was too limited, so, Aristotle says, is his notion of 'necessity' too limited. Democritus' theory of necessity had neglected a meaning of 'necessary' which involves purpose, function, or 'final cause'. There is, Aristotle claims, a meaning of 'necessary' that does involve purpose: if object A is to have purpose or function or goal B, it is necessary that it have or be characterized by C; if it is the purpose of man to contemplate, it is necessary that he have a certain organ or capacity which will perform that function: ἡ δ' ἀνάγκη ὅτε μὲν σημαίνει ὅτι εἰ ἔχειν ἔσται τὸ οὐ ἔνεκα, ταῦτα ἀνάγκη ἔστιν ἔχειν--642a32-34. Necessity is not at all incompatible with purpose or final cause, and Democritus' neglect of the latter unduly narrows his view of 'necessity'. But more on that soon.

Now, in returning to the teaching of Democritus, we need to consider briefly the further question of whether in this absolutely determined universe there is a factor like 'chance'. And this question is further complicated by the fact that Aristotle at Physics 2.4--though he does not mention Democritus by name--presents three apparently different views of the working of 'chance'; and all three of these views have been identified

with Democritus' teaching by later authors.

The first of these views is outlined at Physics 2.4, 196a1-7; there Aristotle mentions the view that we would most naturally connect with the teachings of Democritus in the light of his relentless determinism, that 'chance' is not really a factor at all in the operation of anything in the universe, that in all the instances in which one ascribes something to chance, one can in fact attribute it to some definite cause other than chance: ὁμοίως δὲ καὶ ἐπὶ τῶν ἄλλων τῶν ἀπὸ τύχης λεγομένων ἀεὶ τι εἶναι λαβεῖν τὸ αἷτιον, ἀλλ' οὐ τύχην--196a5-7. This is the view which is attributed to Democritus by Eudemus;⁴⁴ and this attribution is likely a correct one.

The second view is presented by Aristotle in the same chapter at 196a24ff. And this view is that the heavens and the whirl (or vortex) which produced the universe (or universes) is a result of 'the automatic' and hence is due to 'chance'.⁴⁵ The meaning of this statement is in question.

⁴⁴According to Simplicius, In Physicorum, p. 330, lines 14ff.: τὸ δὲ καθάπερ ὁ παλαιὸς λόγος ὁ ἀναιρῶν τὴν τύχην πρὸς Δημόκριτον ἔοικεν εἰρῆσθαι . . . οὐδενός φησι εἶναι τὴν τύχην αἷτιαν ἀναφέρων εἰς ἄλλας αἷτίας . . . οὕτως γὰρ ὁ Εὐδήμος ἱστορεῖ.

⁴⁵I translate ταυτόμαστον as 'the automatic', following Charlton, op. cit., p. 105, rather than as 'spontaneity' to avoid "misleading connotations of acting out of free will." Charlton, citing only the discussion of Bailey, op. cit., feels that only this second view is to be attributed to Democritus. The witness to the fact that this view also represents the teaching of Democritus is again Simplicius, In Physicorum p. 331, lines 15ff.

Kirk and Raven suppose that this means that the whirl does not occur by the usual necessity and atomic laws of motion; they claim: "a vortex would presumably not necessarily arise out of the circumstances of the first stage alone."⁴⁶ And thus, they say, the "whirl is called necessity because it produces the necessary . . . collisions and unions of atoms"(p. 412, note 1). This view represented by Kirk and Raven seems to be inadequate, for it does not explain why the heavens too as they now are (τοῦπανοῦ τοῦδε --Physics 2.4, 196a25) are also and apparently in the same sense said to be due to 'the automatic' or 'chance'; indeed, Aristotle makes much of the contrast between plants and animals close to us on the one hand and the heavens on the other hand more remote from us in space, of which Democritus teaches that the former are not due to chance, while the latter is (196a28-b5); and the contrast that Aristotle makes is not between 'necessity' and 'chance', but between 'chance' and 'not by chance'. And therefore, if the whirl is called 'necessity' because it produces the necessary collisions of atoms, as Kirk and Raven claim, then this certainly contradicts Aristotle's statement that 'the automatic' is responsible for the present heavens and universes (196a25). But surely we are not to suppose that both the whirl and the operating of the present heavens are not subject to the laws of atomic motion and are not the result of them! And besides, what then are we to make of the statement that,

⁴⁶Kirk and Raven, op. cit., p. 411.

according to Democritus, "everything from eternity is absolutely subject to necessity" (Diels-Kranz 68A39)? Certainly this would have developed an irreparable inconsistency in the system of Democritus, and Aristotle would surely have remarked on it.

By far the most reasonable explanation of this statement is that of Goedeckemeyer and the one accepted by Bailey;⁴⁷ and that is to accept as well the third view listed by Aristotle at 196b5-9 as substantially that of Democritus too--that 'chance' is indeed a cause, but one unclear to human intelligence. That this, as well as the first two views, represents the teaching of Democritus is supported by a citation in Theodoret, stating that Democritus, among others, had named τύχη a cause, but one unclear to human reason: ἄδηλον αἰτίαν ἀνθρωπίνῳ λόγῳ.⁴⁸ What then did Democritus really mean by 'chance'? It evidently has a subjective meaning for an objective process which either because of its extreme complexity or remoteness or both cannot be specifically attributed to atomic movements and reactions of a definite kind. Goedeckemeyer describes it as a cause which "wegen der ἀταξία ihrer objectiv durchaus determinierten Bewegung dem Menschen zu einem Schluss

⁴⁷Goedeckemeyer, op. cit., pp. 37-40; Bailey, op. cit., pp. 139-143.

⁴⁸Theodoret 6.15, as cited in Diels, Doxographi Graeci, p. 326. One might note the striking similarity in formulation to the passage in Aristotle which reads: αἰτία ἡ τύχη, ἄδηλος δὲ ἀνθρωπίνῃ διανοίᾳ --196b6.

auf ihre Wirkung keine Anhaltspunkte gewahrt."⁴⁹ And quite evidently the disorder or chaos which preceeded the whirl was precisely of this nature; hence the whirl can certainly be described as being due to the 'automatic' or 'chance'. The heavens then also quite evidently presented for Democritus such complex motions that he could present no comprehensive account of their complexity; they were, besides, far removed, and this would in his view further complicate things, for, as we have seen, their remoteness impairs our accurate observance of their functioning: comets themselves, although they appear to be single objects, are really complexes of stars (Meteorology 1.6, 342b27-29). Thus Democritus' view of chance and necessity are not at all incompatible; they are precise and technical terms quite consistent with one another.⁵⁰

Aristotle's primary criticism of this view of 'chance' is one which applies to the whole theory, including all three of the aspects of that theory which he had listed. It is directed precisely against 'chance' as a mechanical necessity; this theory, Aristotle claims, is simply contrary to empirical fact: "it is even more illogical to make these claims when people see nothing in the heavens happening as a result of a

⁴⁹Op. cit., pp. 39-40.

⁵⁰See also the account of Gregory Vlastos, "Ethics and Physics in Democritus, II" in Philosophical Review, LV (1946), p. 63, where he defines Democritus' 'chance' (τύχη) as "events uncontrolled by art." Democritus' term for 'chance' in matters not concerned with human endeavors and art was likely to αὐτόματον. see Goedeckemeyer, op. cit., p. 37.

(complex) 'automatic' chance, while among things which they claim are not a result of chance, many things do occur as a result of chance."⁵¹ It is not a matter of the heavens' by Democritus' view having an inferior cause, as Cherniss suggests,⁵² but there is simply more order and regularity evident in that realm there than there is here on earth with plants and animals;⁵³ the laws of motion should certainly more appropriately apply up there than among us where there is more evidence of complexity. Democritus' theory, Aristotle thus says with some justification, is not warrented by the observable facts.

Furthermore, Aristotle says that Democritus' use of the word 'chance' is contrary to ordinary usage; we do not, he claims, use 'chance' in connection with things which always happen in a certain way or which so happen for the most part (Physics 2.5, 196b10-13); and so ordinary usage is the direct contrary of the way in which Democritus has been seen to use the term, for, for him, 'chance' is indeed one of those factors which really is a subdivision of 'what always happens', what

⁵¹Physics 2.4, 196b2-4: ἔτι ἀτοπώτερον τὸ λέγειν ταῦτα ὁρῶντας ἐν μὲν τῷ οὐρανῷ οὐδὲν ἀπὸ ταύτοματου γιγνόμενον, ἐν δὲ τοῖς οὐκ ἀπὸ τύχης πολλὰ συμβαίνοντα ἀπὸ τύχης. This is repeated at On the Parts of Animals 1.1, 641b16-23 in more detail, but with the same claim for empirical evidence (φαίνεται, --641b19).

⁵²Op. cit., p. 247, though I am in substantial agreement with most of the rest of what he says on necessity and chance.

⁵³Part. Anim. 1.1, 641b19-20: τὸ γοῦν τεταγμένον καὶ τὸ ὁρισμένον πολὺ μᾶλλον φαίνεται ἐν τοῖς οὐρανοῖς ἢ περὶ ἡμᾶς.

happens of necessity.⁵⁴

Indeed Aristotle says that we ordinarily use the term in connection with some set purpose or end--whether this is intention on the part of human beings or a normal end of development in natural objects. For example, we may go to market for some purpose, meet someone whom we wanted to see for some other purpose, and thus be diverted from that original purpose; or a foetus may usually grow into a human being, but due to some accident be diverted from that end and develop into a monstrosity; and in both instances we call that which happens accidentally 'due to chance'. Thus, Aristotle says: "as many things as are done as a result of intention or happen as a result of a natural process, are for the sake of something; indeed, whenever such things happen accidentally, we say that they happen as a result of chance."⁵⁵ Thus, it is Aristotle's claim that Democritus' use of 'chance' not only fails to accord with ordinary usage (in that Democritus applies it to the category of 'what always happens'), but it also fails to account for the factor of purpose or end in our ordinary usage of that term. And it is this very matter of purpose, end, and 'final cause' which we shall treat next.

⁵⁴Physics 2.5, 196b13-15: ἀλλ' ἐπειδὴ ἔστιν ἃ γίγνεται καὶ παρὰ ταῦτα, καὶ ταῦτα πάντες φασὶν εἶναι ἀπὸ τύχης (*italics mine*, in order to indicate Aristotle's claim for 'ordinary usage' of the term).

⁵⁵Physics 2.5, 196b21-24: ἔστι δ' ἕνεκά του ὅσα τε ἀπὸ διανοίας ἂν πραχθεῖη καὶ ὅσα ἀπὸ φύσεως. τὰ δὲ τοιαῦτα ὅταν κατὰ συμβεβηκός γένηται, ἀπὸ τύχης φημὲν εἶναι (*italics mine*).

The Final Cause

Democritus' teaching on this 'final cause' as a factor in providing an explanation is not hard to indicate; he quite evidently did not use it at all. At best the only analogue to 'final cause' in the teaching of Democritus is simply that A results from B. And precisely this is indicated at On Respiration 4, 471b30-472a2: "Democritus says that as a result of breathing some specific thing happens to creatures which breathe, and he mentions that it prevents their soul from being squeezed out; but he has said nothing at all about the fact that it was for this purpose or end that nature did this."⁵⁶ Further instances of Democritus' analogue to 'final cause'--or, better, his failure to take purpose or end into consideration--will be given in connection with Aristotle's criticisms, where they more properly belong. It seems quite evident that Democritus' failure in this respect was general and consistent.

Inasmuch as Democritus had no positive teaching on this point, it will be the burden of this section of the chapter to show Aristotle's own justification for considering the 'final cause' as an essential element in the explanation of the world of nature and, in regard to Democritus specifically, to show how his neglect of this factor rendered Democritus' theory in-

⁵⁶ Δημόκριτος δ' ὅτι μὲν ἐκ τῆς ἀναπνοῆς συμβαίνει τι τοῖς ἀναπνέουσι λέγει, φάσκων κωλύειν ἐκθλίβεσθαι τὴν ψυχὴν. οὐ μέντοι ὡς τούτου γ' ἔνεκα ποιήσασαν τοῦτο τὴν φύσιν οὐθὲν εἴρηκεν. There is an obvious contrast between ἐκ τῆς ἀναπνοῆς and τούτου ἔνεκα, each placed at the beginning of its clause.

adequate.

Aristotle's general case for including the 'final cause' as an avenue of explanation is presented at Physics 2.8.

There is, Aristotle there claims, a purpose or an end in the functioning of art (τέχνη); things are done for some specific purpose: *πράττεται δ' ἕνεκά του*--199a11. The example to which Aristotle refers here is that of house-building (a fairly frequent example); its purpose is realized when the house is in fact built. Another favorite example is the skill of healing (mentioned briefly at 199a34-35), and its purpose is fulfilled when the person is in fact restored to health. So there are indeed things which are done for the sake of something, for some purpose or end.

And this 'doing something for some purpose or end', Aristotle further claims, is evident even among the lower animals, such as spiders and ants--though on this level there is no question of doing it as a matter of art or technical skill (τέχνη) or of deliberate intention (199a20-23).⁵⁷ And, as one goes down the scale of nature to plants, the growth of plants is a continuing process, and things that happen to it as part of that process, happen to it in relation to some end or goal of that process (*γινόμενα πρὸς τὸ τέλος*--199a24-25); and thus here too there is an end or goal with reference to which cer-

⁵⁷In the light of this remark we ought to divorce from the οὐ ἕνεκα as such any idea of intention or deliberate purpose; thus, if the proverbial acorn succeeds in growing into an oak tree and thus fulfilling its 'purpose', we ought not anthropomorphize it or attribute to it any real intention.

tain things happen in certain ways in the process of growth--thus its roots grow downward with reference to the goal of constantly obtaining nourishment. Thus considering the goal or function of a plant or a part of a plant contributes to our understanding of the process of its growth as a whole (199a23-30).

More specifically, a consideration of the goal, end, or purpose of a given natural physical object can help us to a better understanding of that object or its parts; it can give us clues to its matter, form, and efficient causes as well. And this is the point that Aristotle makes about the hypothetical necessity which involves the final cause at On the Parts of Animals 1.1, 642a31-34. There might be some doubt, for instance, about the constitution of some organ or part of a natural object or about some other factor in some natural process; thus, by considering the end or purpose of that process or the proper functioning of that organ or part, one might by using the hypothetical necessity formula come to some conclusion about these other doubtful factors: if its purpose or end or function is A, then it is necessary that it have B. Hence this 'final cause' too is one of which the natural philosopher must be aware and for which he must account (Physics 2.7, 198a21-24) and thus give a complete explanation of the physical object in question (198b4-5).

A parallel which to some extent illustrates this approach to scientific explanation turns up somewhat unexpected-

ly in a symposium devoted primarily to quantum mechanics and is worth quoting:⁵⁸

"We are not asked to look at what we cannot yet see, but only told to look at the given elements of the problem in a particular way, namely as putative clues to the unknown solution. By concentrating our attention on an unknown end in terms of the clues by which it may be achieved, we may succeed in reorganizing these clues into a satisfactory solution of our problem; and we may add that if we looked at the clues themselves, without any purpose in mind, they would mean nothing to us."

Similarly for Aristotle, the end or purpose of a process can give us valuable insight into other factors involved; it can, as Polanyi in his own instance points out, help us to know particulars focally; it can help us to settle what is in doubt.

And this is precisely the point on which Aristotle criticizes Democritus in regard to the 'final cause'. Nowhere, as far as I know, does Aristotle simply say that Democritus was wrong only because he did not consider the 'final cause'; but on all occasions of Aristotle's criticism of Democritus in regard to the 'final cause' Aristotle regularly says that Democritus' neglect of the 'final cause' led him to an accounting--which is on other grounds inadequate--of the matter constituting a part of an organ or an object, of the structure or form of an object, and of the operation of a natural process.

⁵⁸Michael Polanyi, "Beauty, Elegance and Reality in Science" in Observation and Interpretation in the Philosophy of Physics: With special reference to quantum mechanics, ed. by S. Korner (New York: Dover Publications, 1957), p. 104. The aim or end of a process, he says, can tell us much about the given facts or particulars. The specific reference here in this quotation is to a mathematical problem, and for this reason the parallelism breaks down at some points.

Thus, according to Aristotle, in all instances Democritus' failure to consider the 'final cause' is not wrong in and of itself, but precisely because it generated other mistakes, as will now become evident as we examine the instances in which Aristotle does mention Democritus' neglect of this avenue of explanation.

First of all, we have already noted that at On the Parts of Animals 1.1 Democritus is said to have defined man's real atomic structure as his form or essence and said that phenomenal man is an accurate and true representation of this real form (640b29-35). And Aristotle's reply was that on those grounds the corpse and the man are actually the same thing inasmuch as they look exactly alike (640b35-36). Then Aristotle goes on to show in some detail that, had Democritus considered the problem from the view-point of 'final cause', he would have obviously avoided this error; for the wooden hand or the portrait of a physician are 'hand' and 'physician' by courtesy of name only; they are not in fact the same as a real hand or physician. And this is made obvious by the fact that they do not perform the proper function of a hand or of a physician: οὐ γὰρ συνήσεται ποιεῖν τὸ αὐτῆς ἔργον (641a2-3); a wooden hand or couch has its own purpose (τίνας ἔνεκα --641a13), and so does a real hand. And this means that there is an obvious distinction between them which must be made and which Democritus in principle could not make. Democritus' neglect of 'final cause' had led him to make an obvious mistake, a

mistake which he could have avoided, had he considered the matter from the point of view of purpose and function.

Again, at On the Parts of Animals 3.4, 665a31-33 Democritus is said to have thought that bloodless animals have viscera just like blooded animals do, but in the former they are invisible due to their smallness. This, Aristotle says rightly, is an unwarranted conclusion, because 'size' in other cases is not a factor; such organs are visible in blooded animals as soon as they are formed and still very small--in eggs as early as the third day, and in aborted embryos when very small (665a33-b2). Thus Democritus seems to be wrong in his assumption (Δημόκριτος δ' ἔοικεν οὐ καλῶς διαλαβεῖν περὶ αὐτῶν--665a31-32); but a consideration of the use (χρῆσις) of different parts for different creatures relative to their own life and movements--a consideration of the functioning of these organs in relation to the cardio-vascular system--would have helped Democritus to avoid making his unwarranted assumption (665b2-17).

At On Respiration 4, 471a16 Democritus is represented as having given an account of breathing which gave the 'efficient cause' as an external pressure and specified that spherical soul-atoms which produce the effect of 'heat' in us are inhaled by animals as an essential part of the continuance of the process of breathing. There is some legitimate doubt as to whether this account is in principle correct or not, for the 'efficient cause' of breathing seems to be more likely inter-

nal than external, and Democritus' related proposition that all animals breathe is not in fact true (472a21-29). Furthermore, Aristotle says in criticism of Democritus' theory, a consideration of the purpose of breathing would have kept Democritus from this apparently wrong account, for evidence points to the fact that we breathe to cool ourselves; and this consideration would have led Democritus to reformulate his account of the material which we breathe, for by his theory what we breathe has the effect of adding heat (472a30-b5).⁵⁹ And these considerations would perhaps as well have led him to reformulate his whole theory of the soul.

At On the Generation of Animals 2.4 Aristotle cites Democritus' view that the external parts of the embryo are developed first and the internal parts only later (740a13-15) and that the embryo stays in the uterus because there it is mechanically formed like its parent (740a37-38). The former view, Aristotle says, is wrong on the grounds of empirical evidence that the heart is formed early (740a4-5), and the second on the grounds that some embryos receive their formation quite apart from the mother, as is the case with those developing in eggs (740b1-2). But, even aside from the empirical evidence for the early development of the heart, reason would have helped Democritus avoid his mistake; and the reason referred to is precisely the hypothetical necessity involved in earlier crit-

⁵⁹See especially 472b4-5: ἀλεόζοντες δὲ πολλάκις ἀναπνέουσιν, ὡς ἀναψύξεως χάριν ἀναπνέοντες, ὅτε τὸ λεγόμενον ποιεῖ πῦρ ἐπὶ πῦρ.

icisms. Once the embryo starts developing, it begins to function independently like seeds sown in the ground (739b34-35); and the independent development of an embryo in an egg should have shown Democritus that. But, if it is to be such as to function independently, it must therefore have an internal principle of development (740a6-9).⁶⁰

Aristotle further criticizes Democritus at On the Generation of Animals 4.1 for his view of the determination of the sex of an offspring. Democritus had apparently said that 'semen' in both parents comes from all parts of the body, and sex is determined in the offspring by whether the semen representing the genital organs of the father or the mother predominates (764a7-12). This view, Aristotle feels, is wrong because male and female are not only different in their genital organs, but are different as whole persons; and so, if that which determines gender does so by predominance, this ought to affect the whole person; and thus there would be no accounting for how daughter can take after father in some respect and son can take after mother in some respects (764b21-31).

And in further response to this teaching Aristotle suggests first that a more satisfactory view could be arrived at by an accounting of the relationship of the blood vessels to the genital organs in terms of a natural process--and thus with

⁶⁰ Aristotle's hypothetical proposition here in the text is a bit more complex, for, as he states it, he is also drawing an analogy to a son becoming independent and setting up his own household.

a view to their proper functioning as part of the whole person. And this would account for the determination of sex and the development of organs of sex as something contingent upon a prior principle (764b32-38); and this Aristotle goes on later to describe in terms of the functioning of male and female as such (765b9-766b26). And this approach allows Aristotle to give a broader and more satisfactory accounting for all the facts. And from this point of view of accounting for all the facts the approach which Aristotle took and which Democritus neglected is certainly justified.

The same is true with regard to Democritus' account of the development of monstrosities as outlined by Aristotle at On the Generation of Animals 4.4. There Democritus had been said to have attributed their development to a second copulation which resulted in the superfluous growth onto the developing embryo (769b32-34). This view seems wrong in the light of the apparent development of monstrosities in animals as the result of a single copulation. But a better avenue of approach, Aristotle says, is to examine the function of the semen from each of the parents; and again such an approach seems to Aristotle to explain more of the facts in a variety of specific instances (770a6ff.).⁶¹

Finally, at On the Generation of Animals 5.8, 788b10-14

⁶¹The matter of interpretation in the light of function goes back to chapter one of this book; it is simply intimated here by reference to ascribing the reason for such monstrosities to the material constituting the embryo; the material is what Aristotle sees as the proper contribution of the female.

Democritus is cited as having explained the early development of front teeth as being due to suckling. And Aristotle immediately points out that Democritus' universal statement in this regard is simply not warranted by the facts (788b15-20). And furthermore Aristotle retorts that Democritus was mistaken because he failed to consider the development of teeth from the point of view of the 'final cause'; and such a consideration would have led him to a more adequate account.

In the first place, with regard to his universal statement about the development of teeth, he would not have made the error he did, if he had considered the fact that these teeth do not have only one purpose or function. Not all animals have them for the same reason or purpose: οὐδὲ πάντα τοῦ αὐτοῦ ἔνεχεν τὰ ζῷα ἔχουσιν --788b3-4. In some cases these teeth serve for obtaining nourishment, and in other cases they are there with a view to self-defense (788b5); and the facts of the case for each animal or kind of animal should be considered before drawing any general conclusion.

Secondly (788b20-29), in those cases, Aristotle says, where such dropping of the front teeth does occur, it is important to remember that the development of those teeth is a natural process, and their end or proper function is performed when they are used as instruments for obtaining nourishment. Whereas, on Democritus' theory, if they ordinarily developed later in life, there would be a long period of time in which the growing animal would have no means for obtaining nourish-

ment after the period of suckling stopped. The growing animal therefore must have these teeth early in life, if he is to obtain nourishment: ἀνάγκη δὲ . . . ἔχειν ὄργανα πρὸς τὴν ἐργασίαν τῆς τροφῆς--788b23-24. A consideration of the purpose or function of these teeth would thus have led to a correct interpretation, that is, that they are developed naturally at that time of life. In this respect too Democritus was led astray by his neglect of 'final cause'. Aristotle then goes on to show how a consideration of function or purpose is better not for its own sake, but because it contributes to a broader and more satisfactory explanation of the mechanics of the growth of teeth (788b30-789b2).

This chapter of On the Generation of Animals (5.8) and, indeed, the whole work ends--as does the first chapter of On the Parts of Animals--with a criticism of Democritus' view of 'necessity' as something in all cases absolute, though the criticism is still made here with reference to the matter of 'dropping of front teeth'. It is necessary that they drop, but there is a contrast between absolute and hypothetical necessity; and Aristotle says: "It is of course true that they are determined by necessity, but at the same time they are for the sake of some purpose, some final cause, and for the sake of that which is better in each case."⁶² There is, Aristotle

⁶²5.8, 789b4-6; the translation is that of A. L. Peck, Aristotle Generation of Animals (London: William Heinemann, 1953), p. 559, although I refuse to follow Peck in capitalizing 'final cause'.

claims once more, a use of hypothetical necessity which can lead to a more satisfactory explanation of form, matter, and efficient cause; and Democritus had consistently neglected it. Thus Aristotle has shown the ways in which that neglect had led him into error on other counts, and has shown as well that a consideration of that factor or an approach to explanation from that point of view has proved fruitful in a broader, more detailed, and thus more satisfactory explanation of the given facts.

But even beyond all this, there is in Aristotle one final criticism of the position of Democritus; it is a criticism which is never quite made explicit, but is certainly strongly implied. 'Final cause' implies for natural objects a natural internal process to some end, goal, or function; and so Democritus' failure to take any account at all of the final cause leaves him with no basis for any real distinction at all between animate and inanimate objects, between natural and artificial objects. Charlton suggests--and the point is well taken--that when Aristotle attempts to distinguish an internal from an external final cause at Physics 2.8, he is attempting to make precisely this distinction; Charlton says: "Aristotle is in effect trying to give an account of the difference we feel there to be between living things and the processes of life on the one hand, and inanimate nature on the other."⁶³

Granting this distinction on Aristotle's part, his crit-

⁶³Op. cit., p. 126.

icism of Democritus becomes almost explicit in the light of the expressions which he uses in connection with Democritus' theory. At On the Generation of Animals 2.4, 740a15-16, in connection with Democritus' teaching on the development of the embryo, Aristotle says that it is as if Democritus were speaking of animals made of wood or stone: ὡπερ ξυλίνων ἢ λιθίνων ζῴων. And this is likely taken up again in connection with the theory of πανσπερμία cited at 4.3; the theory is described as a 'fabrication' (πλασματίας --769b1). It is taken up again at On the Parts of Animals 1.1, where on Democritus' principles there is according to Aristotle no real distinction between a man and a corpse, that on this theory one could not distinguish a bronze or a wooden hand from a real one: οἷον [χεῖρα] χαλκῆν ἢ ξυλίνην--640b36ff. All of these instances render even more significant the more familiar passage at On the Soul 1.3, 406b17-20: "Democritus' account is quite like that of Philip the master of comedy, for the latter says that Daedalus made a wooden statue of Venus move by pouring in quicksilver." Animate life in Democritus' view is no different from the mechanical and artificial 'life' induced into 'gimmick' statues. Democritus in Aristotle's view had come to the point of denying one of the most obvious facts of the phenomenal world--natural life. '

Thus all of Democritus' accounts of causes and of necessity had without sufficient warrent at all led him to deny that there are in fact such real things as natural objects

which could in principle be distinguished from artificial objects. And Aristotle had shown in case after case precisely how he went wrong and that the weight of the evidence certainly did point to the fact that Aristotle's account was more satisfactory and more justified.

SOME CONCLUDING REMARKS

It may be well at this point to append a few words in retrospect, to see what--if anything at all--has been gained by this review of Aristotle's accounts and criticisms of Democritus. The fundamental issues--as Aristotle himself saw them--dividing the teachings of these two significant philosophers of the ancient world have now been raised. And these are issues which are still of living concern to philosophers today--the problem of 'what exists' and 'what does not exist', of what constitutes a 'physical object', of sense-perception and knowledge, the problem of how we are to go about explaining and describing the world around us, and the very problem of the meaning of life.

Admittedly, in regard to the basic thesis of this paper, the reliability of Aristotle's accounts and criticisms of Democritus, there is no answer or resolution of the problem in terms of absolute certainty--nor can there be short of finding Democritus' own writings on physical theory substantially intact. The fragments that we do have, although they are in fact numerous, tell us even less upon which we can rely with absolute certainty; they have been torn out of context, and with the context much of their meaning and significance has also disappeared. And perhaps with the passage of time, when these

fragments were finally written down by the ancient authors who preserved them for us, even their words and significance has been contaminated with new meanings and related but foreign teaching. And so, when we consider them, we are still reduced to engaging in a great deal of conjecture and sheer speculation.

But the distance between Abdera and Stagira--either in terms of time or space or in concern for philosophic issues--is not so great. Aristotle is indeed our first and fullest explicit witness to the teachings of Democritus; he had evidently read Democritus thoroughly and he presents Democritus' teachings in a philosophical context. And it is here in Aristotle that the meaning and significance of the teachings of Democritus take shape and form--to such an extent as they could not possibly do from only the fragments. If we are to understand Democritus at all, we must go to Aristotle. And, though even here there is no absolute certainty, at least we can by using Aristotle with caution arrive at what is most likely and probable in regard to the teachings of Democritus.

And if Cherniss' book has taught us anything at all about Aristotle's witness to the Presocratics, it has rightly taught us caution, it has taught us to read Aristotle more closely, and it has taught us not to take Aristotle's reports and criticisms out of context. And this is wholesome, for it does indeed help us to a more reliable view not only of Aristotle himself, but also of Democritus and of the other earlier

philosophers.

More specifically though, in regard to Cherniss' charges against Aristotle of misrepresentation of various sorts, we have seen that Cherniss--at least as far as Democritus is concerned--certainly does not prove misrepresentation. Indeed, in all cases the likelihood rests with a reasonably accurate representation by Aristotle of the theory of Democritus. And Aristotle's criticisms--in spite of some objections by Cherniss--were seen to be warranted by the facts of the case and by the evidence available.

Although the primary value of this paper is to counter-balance some of the extreme views critical of Aristotle's treatment of his predecessors, there are several respects in which our closer reading of Aristotle has, I believe, led to a fuller and more complete understanding of the teachings of Democritus. The first of these is the fuller integration of the meaning of $\pi\alpha\nu\omicron\pi\epsilon\rho\mu\acute{\epsilon}\lambda\alpha$ into the teachings of Democritus--as a term used not only in connection with the atomic structure of physical objects and the mutual generation of the 'traditional elements', but also in connection with Democritus' solution to the problem of the presence of contraries in physical objects. And the other is a theory of 'truth in perception' which does sufficient justice not only to all that Aristotle says about Democritus' teachings, but also to the witness of later writers and the fragments--taking 'true' to mean an accurate correspondence between what is perceived by the senses and the actual

atomic structure of physical objects, a correspondence which holds as well for the physical processes, and thus establishes a connection between the 'necessity' which governs the atoms and their movements and the 'necessity' which we observe in the phenomenal world as the objects in it move and change.

Thus, on the whole, this paper, I hope, has led to a greater appreciation of Aristotle as a philosopher with integrity and to increased insight into the consistent and methodical teachings of Democritus.

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APPROVAL SHEET

This dissertation submitted by Richard W. Baldes has been read and approved by the members of the Department of Classical Studies, Loyola University, Chicago.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Jan 14, 1972

Date

Rev. Lothar S. Nurnberger, S.J.

Lothar Nurnberger, S.J.,
Dissertation Director